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DRAFT

COMBINED TOTAL MAXIMUM DAILY LOAD & POLLUTANT REDUCTION PLAN FOR CHRISTINA RIVER BASIN, GOOSE CREEK, EAST BRANCH CHESTER CREEK AND CHESTER CREEK WATERSHEDS WEST GOSHEN TOWNSHIP

August 2017

CHESTER COUNTY, PENNSYLVANIA

HRG Project No. R004194.0430

COMBINED TOTAL MAXIMUM DAILY LOAD &
POLLUTANT REDUCTION PLAN
FOR
CHRISTINA RIVER BASIN, GOOSE CREEK, EAST BRANCH CHESTER CREEK AND CHESTER CREEK WATERSHEDS
WEST GOSHEN TOWNSHIP

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Introduction

The following Combined Total Maximum Daily Load (TMDL) Plan addresses how the Township of West Goshen, Chester County, Pennsylvania intends to meet the pollutant reduction requirements prescribed in the TMDL report dated June 30, 2008 entitled, "Nutrient Total Maximum Daily Load in Goose Creek Watershed, Pennsylvania," as well as the pollutant reductions prescribed in the TMDL report dated September, 2006 entitled, "Total Maximum Daily Loads for Bacteria and Sediment in the Christina River Basin, Pennsylvania, Delaware, and Maryland" as established by the United States Environmental Protection Agency Region III. The prescribed nutrient pollutant load reductions will be achieved using the "Presumptive Approach," focusing on sediment reduction as a means of measuring the effectiveness of the Best Management Practices (BMPs) proposed herein to reduce nitrogen and phosphorus loads.

This document was prepared following the guidance provided in the Pennsylvania Department of Environmental Protection (PADEP) document 3800-PM-BCW0200d - National Pollutant Discharge Elimination System (NPDES) Individual Permit to Discharge Stormwater from Small Municipal Separate Storm Sewer Systems (Ms4s) TMDL Plan Instructions, revised March of 2017).

GENERAL INFORMATION	
Permittee: West Goshen Township	**NPDES Permit No.:** PAI130532
Mailing Address: 1025 Paoli Pike	**Effective Date:** February 13, 2004
City, State, Zip: West Chester, PA 19380	**Expiration Date:** Administratively Extended
MS4 Contact Person: Rick J. Craig, P.E., CSM	**Renewal Due Date:** September 16, 2017
Title: Township Engineer	**Municipality:** West Goshen Township
Phone: 610-696-5266	**County:** Chester
Email: rcraig@westgoshen.org	**Consultant Name:** Erin Letavic, P.E. Herbert, Rowland & Grubic, Inc. 369 East Park Drive Harrisburg, PA 17111 717-564-1121
Co-Permittees (if applicable): N/A	

Located in eastern Chester County, Pennsylvania; West Goshen Township is an MS4 community (PAI 130532) currently in its second permit term. The entire township is classified as an Urbanized Area (UA) according to the United States Census Bureau's 2010 census. The western portion of the township lies within the Brandywine Creek Watershed and the central and eastern portions comprise parts of the Chester Creek and East Branch Chester Creek Watersheds.

The above mentioned Brandywine Creek Watershed is a sub-watershed of the Christina River Basin, encompassing approximately 2,362 acres in the western region of West Goshen Township. Many of the stream reaches within the Brandywine Creek Watershed have been classified by the Pennsylvania Department of Environmental Protection as impaired, including those located within West Goshen Township.

Goose Creek Watershed, a sub-watershed of the Chester Creek Watershed, encompasses approximately 1,488 acres in the south central region of West Goshen Township. Many of the stream segments within the Goose Creek Watershed have also been classified by the Pennsylvania Department of Environmental Protection as impaired, including those located within West Goshen Township. The EPA's Goose Creek Watershed TMDL Report establishes a Total Phosphorus (TP) TMDL for the Goose Creek Watershed and provides a total phosphorus Waste Load Allocation (WLA) to each of the MS4s in the watershed.

Further, the Township is required to prepare a pollutant reduction plan for sediment-impaired streams that discharge to the East Branch Chester Creek. Being that all of these surface waters ultimately drain to the Delaware River, and the goals for water quality can be accomplished at the same time, the planning area used to calculate sediment reduction goals and achievements combine the watersheds with TMDL and Appendix E-Siltation requirements.

Section A: Public Participation

A complete copy of this Combined TMDL Plan was made available for the public to review at the West Goshen Township Municipal Office from July 26, 2017 to August 25, 2017. The availability of the document was publicized in Daily Local News (August 1, 2017). The published public notice contained a brief description of the plan, the dates and locations at which the plan was available for review by the public, and the length of time provided for the receipt of comments.

A copy of the public notice is included in Appendix A. Public comments were accepted for 30 days following the publication date of the public notice. ~~X Number~~ of public comments were received. Copies of all public comments and the responses issued to each comment are included in Appendix A.

A public meeting was held on July 26, 2017 at West Goshen Township Municipal Building to present the information contained in this report to the public. Comments and questions regarding the Combined TMDL Plan were received during the public presentation. A copy of the meeting minutes for the meeting at which the Combined TMDL Plan was presented are included in Appendix A.

Section B: Map

The maps located in Appendix B of this report, depicts West Goshen's complete Municipal Separate Storm Sewer System (MS4), as required by the National Pollutant Discharge Elimination System (NPDES) Individual Permit to Discharge Stormwater from Small Municipal Separate Storm Sewer Systems (MS4s) Application Instructions[1]. West Goshen's urbanized area located within the Brandywine and Chester Creek Watersheds is to be considered the planning area for the purpose of this Combined TMDL Plan. The Planning Area encompasses the entire municipality, with the exception of a 715 acre portion of the Valley Creek Watershed (HUC 12 Code 020402050104), located in the northwest corner of the Township. The Valley Creek Watershed has been associated with no PRP or TMDL requirements due to the unknown source of impairment. The Combined TMDL Planning Area encompasses approximately 6,925 acres of land within West Goshen Township. All water courses, inlets, pipes, outfalls, observation points, existing BMPs, and proposed BMP locations within the planning area have been located and identified on the MS4 maps.

A Land Use Map of the Planning Area was developed using the most recent National Land Cover Database[2]. The northern portion of the Township is largely residential with a large pocket of forested land approaching the center of the Township. The majority of Township's higher density mixed-use development is located in the center and western portions of the municipality near its boundary with West Chester Borough. The southeast quadrant of the Township exists as mainly medium density residential development.

[1] PADEP, form 3800-PM-BCW0200a, (rev. 1/2017)
[2] Multi-Resolution Land Characteristics (MRLC) Consortium, *National Land Cover Database 2011* (NLCD 2011)

Section C: Pollutants of Concern

The pollutants of concern for the Planning Area were determined by referencing the PADEP MS4 Municipal Requirements Table[3] (Table 1). The applicable sections of this table are included for reference in Appendix C.

Table 1. Pollutants of Concern by Watershed

Watershed	Pollutants of Concern
Goose Creek	TMDL - Nutrients (TP, TN)
Christina River Basin - TMDL	TMDL - Sediment (TSS)
East Branch Chester Creek	Appendix E - Siltation (TSS)
Chester Creek	Appendix E - Siltation (TSS)

Likely sources of these pollutants in the Planning Area are identified below.

Sediment (TSS):

- Streambank erosion
- Construction / earth moving activities
- Urban runoff
- Lack of adequate stream buffer

Nutrients (TN, TP):

- Lack of adequate stream buffer
- Heavy use of lawn fertilizers
- Agricultural activities
- Urban runoff

Since the Combined TMDL Planning Area includes the East Branch Chester Creek and Chester Creek Watersheds, the 10 % sediment load reductions prescribed by both Appendix E PRPs listed above will be achieved through the implementation of the Short-Term Goals listed in this Combined TMDL Plan. The ability to combine planning requirements is attained by PADEP in the TMDL Plan instructions [3].

[3] PADEP, MS4 Requirements Table (Municipal) (rev. 6/26/2017)
[4] PADEP, TMDL Plan Instructions (rev. 3/2017)

Section D: Existing Load for Pollutants of Concern

Baseline and existing pollutant load calculations were computed for the Planning Area using MapShed modeling software, version 1.5.0. MapShed is a "GIS-based watershed modeling tool that uses hydrology, land cover, soils, topography, weather, pollutant discharges, and other critical environmental data to model sediment and nutrient transport within a watershed."[4] This program calculates the existing pollutant loading in terms of pounds per year and evaluates BMP-based pollutant reductions using the DEP - approved BMP effectiveness values[5]. All GIS data used to create the pollutant baseline loading model was sourced from the MapShed Download web site.[6] The Mapshed modeling software was used to calculate the Township's existing pollutant loads discharging to the Upper and Lower East Brandywine Creek watersheds, as well as the Chester and East Branch Chester Creek watersheds. The area contains the impaired reaches of the East Branch Chester Creek and Chester Creek listed in PADEP's MS4 Municipal Requirements Table, which necessitate Appendix E PRPs for siltation. Since both impaired creeks are included in the Combined TMDL Planning Area, the required pollutant load reductions for both impaired watersheds will be achieved through the implementation of the Township's Combined TMDL Plan, as suggested by PADEP's Pollutant Aggregation Table Instructions. A summary of pollutant loading for the Combined TMDL Planning Area is shown in Table 3.

Table 3. Baseline Pollutant Loading for Planning Area

Watershed	Urbanized Area (Acres)	Baseline Pollutant Loading (lbs./yr.)		
		TSS	TN	TP
Combined TMDL Planning Area	6,925	3,799,869	29,756	2,053

Mapshed modeling results for the Township's Baseline and Existing Pollutant Loads are included in Appendix D. Certain properties were parsed from the modeling area due to their individual stormwater quality obligations (Appendix D). A modest assumption that 15% of the existing streams in the Planning Area were adjoined by a forested buffer area, 35 feet in width, was made based on a review of satellite imagery from April 2016 and based upon local knowledge. A stream flow volume adjustment factor of 0.5 was used to calibrate the model and bring baseline sediment loads to a level consistent with those reported in the Christina River Basin TMDL Report. Existing detention basins were not included in the model, as Mapshed 1.5 offers no water quality benefit to standard detention basins. A 488 acre forested area northwest of the intersection of West Chester Bypass and Phoenixville Pike, is disconnected from the Township's MS4, and modeled as an area direct drainage. Runoff from the forested area drains directly to either Taylor Run, or an UNT to Taylor Run. Using Mapshed's Urbanized Area Viewer tool (UA Viewer), the Baseline Pollutant Loads for the West Goshen Township Combined TMDL Planning Area were determined (Table 4).

5. Evans, B., & Corradini, K. (n.d.). MapShed Overview Page. Retrieved August 18, 2015, from http://www.mapshed.psu.edu/overview.htm
6. PADEP form 3800-PM-BCW0100m, revised 05/2016
7. Evans, B., & Corradini, K. (2015) MapShed Download Page. Retrieved August 15, 2015, from http://www.mapshed.psu.edu/download.htm

Table 4. Baseline Pollutant Loading by Source

Source	Baseline Pollutant Load by Source (lbs/yr)		
	TSS	TN	TP
Land-Based Load	750,974	10,099	1,325
In-Stream Load	3,048,895	1607	440
Septic	0	64	0
Total Baseline Loading	**3,799,869**	**11,770**	**1,765**

The Township's baseline pollutant loads are summarized by source in Table 4. The MapShed model results demonstrate that approximately 72% of the Township's sediment load or 1,574,978 pounds of sediment per year is attributed to streambank erosion. Land-based sources and land uses contribute a smaller percentage of the total sediment load, 28% or 601,643 pounds per year, but are greater contributors of nutrient loading.

Table 5: Existing BMP Sediment Load Reductions (Appendix D)

BMP Type	Location (Lat. / Long.)	Map Reference	HUC 12 Watershed	TSS Reduction (lbs./yr.)
Bicking Basin Retrofit	39,952347°, -75.570360°	EX-01	Chester Creek	56,800
Total Existing BMP TSS Load Reduction				**56,800 lbs./yr.**

Existing pollutant load modeling calculations include pollutant load reductions from one existing BMP, EX-01 (Table 5). West Goshen Township conducted a detention basin retrofit on a large basin in 2009. The basin, known as the Bicking Basin, serves as the main stormwater management facility for a large residential development in the southeast corner of the Township. The 30,000 square foot basin manages storm runoff from the 128 acre drainage area located to the north and east of the basin. During the retrofit, the entire basin bottom was naturalized with amended soil and wetland plantings which are now mature. The existing corrugated metal riser was replaced with a new 24 inch diameter HDPE riser. The new riser provides extended detention with two one-inch circular orifices located 6 inches above the outlet invert and two additional one-inch orifices for each foot of vertical rise of the riser pipe.

Table 6. Existing Pollutant Loads

Source	Combined TMDL Planning Area Baseline Pollutant Load by Source (lbs/yr)		
	TSS	TN	TP
Baseline Pollutant Loading	3,799,869	11,770	1,764
Existing BMP Load Reductions	56,800	157	24
Existing Pollutant Loading	**3,743,069**	**11,613**	**1,740**

The Combined TMDL Planning Area's existing sediment load was determined to be 3,743,069 pounds per year (Table 6). Existing load calculations are included in Appendix D.

Section E: Wasteload Allocations (WLAs)

West Goshen Township was assigned a Wasteload Allocation for total phosphorous stating that no more than 0.54 pound per day of total phosphorous shall be discharged from the Township's MS4 into the Goose Creek Watershed (Table 7). The WLA is listed on page 3-6 of the June 30, 2008 TMDL report entitled, "Nutrient Total Maximum Daily Load in Goose Creek Watershed, Pennsylvania."

Table 7. Goose Creek MS4 Waste Load Allocations (WLA) and Required Reduction:

MS4 Permittee	Existing TP Load (lb/day)	TP WLA (lb/day)	Required Reduction
West Goshen Twp.	1.16	0.54	53.9%

*Current TP load as listed in TMDL Report. See Section D for recalculated Baseline Pollutant Loads.

West Goshen Township was also assigned a Wasteload Allocation for sediment stating that the discharge from the Township's MS4 shall contribute no more than 184 tons of sediment to the Christina River Basin Watershed (Table 8). The WLA is listed on page 4-16 of the 2006 TMDL report entitled, "Total Maximum Daily Loads for Bacteria and Sediment in the Christina River Basin, Pennsylvania, Delaware, and Maryland."

Table 8. Christina River Basin MS4 Waste Load Allocations (WLA) and Required Reduction:

MS4 Permittee	Baseline Sediment Load (tons/year)	Sediment WLA (tons/year)	Required Reduction
West Goshen Twp.	470	184	60.87%

*Current sediment load as listed in TMDL Report. See Section D for recalculated Baseline Pollutant Loads.

Section F: Analysis of TMDL Objectives

1. Long-Term Reduction: West Goshen Township intends to achieve the required long-term pollutant load reduction goals prescribed by the EPA's Goose Creek Watershed and Christina River Basin TMDL Reports through continued implementation of the pollutant load reducing BMPs and educational activities over several future MS4 Permit terms. The Township will continue to review and revise the approved TMDL Plan and work to identify and develop future projects that will provide water quality benefits to the receiving waters of the MS4. Long-term load reduction requirements for each WLA-associated pollutant have been calculated for each watershed (Table 9.).

Table 9: Long-Term Pollutant Load Reduction (Appendix F)

Watershed	Impairment	Existing Pollutant Load*	Percent Reduction Required	Long-Term Pollutant Loading Goal
Christina River Basin	Sediment / Siltation	828,378 lbs./yr.	60.87%	324,144 lbs./yr. TSS
Goose Creek Watershed	Total Phosphorus	1,078 lbs./yr.	53.9%	497 lbs./yr. TP

*Based on individual watershed, not Combined TMDL Planning Area

2. Short-Term Reduction: Utilizing the "Presumptive Approach," as described in PADEP's TMDL Plan Instruction Document 3800-PM-BCW0200d, West Goshen Township intends to achieve the required short-term sediment load reduction goals through construction, operation and maintenance of the five pollutant load reducing BMPs proposed herein. The BMPs have been located throughout the Planning Area to achieve sediment load reductions in both TMDL watersheds, as well as the two impaired Appendix E, PRP watersheds. Short-term sediment load reduction requirements have been quantified for the Combine TMDL Planning Area (Table 10).

Table 10: Short-Term Pollutant Load Reduction (Appendix F)

Watershed	Impairment	Existing Pollutant Load**	Percent Reduction Required	Reduction Required (lbs./yr.)	Short-Term Pollutant Loading Goal (lbs./yr.)
Combined TMDL Planning Area	Sediment / Siltation	3,743,069	10%	374,307	3,368,762

**Based on Combined TMDL Planning Area calculated using Mapshed modeling software

Section G: Select BMPs to Achieve Minimum Required Reductions

1. Short-Term Reductions for Permit Term:

The following BMP strategy represents an effective approach to meeting the required reduction goals of the Short-term TMDL requirements for the Goose Creek and Christina River Basin Watersheds, as well as the load reductions required by the Appendix E PRPs for Chester Creek and East Branch Chester Creek Watersheds. The proposed BMPs include streambank stabilization, riparian forest buffer restoration, and detention basin retrofits throughout the Township's urbanized area. The sediment load reductions achieved through the implementation of the proposed BMPs described herein were determined through the use of the same MapShed model used to determine the Township's Baseline and Existing Sediment Loads.

Table 11: Proposed BMPs for Short-term Sediment Load Reduction Strategy (Appendix F)

BMP Type	Location (Lat. / Long.)	Map Reference	Watershed	TSS Reduction (lbs/yr)
Hamilton Drive Detention Basin Retrofit	39.995733° , -75.611727°	BMP-01	Lower East Branch Brandywine	13,800
Farren Drive Detention Basin Retrofit	39.998006° , -75.612304°	BMP-02	Lower East Branch Brandywine	13,200
Hagerty Lane Stream Restoration	39.948947° , -75.581787°	BMP-03	Chester Creek	132,250
Westtown Road Stream Restoration	39.958095°, -75.584041°	BMP-04	Chester Creek	198,375
Westtown Road Detention Basin Retrofits & Constructed Wetlands	39.958095°, -75.584041°	BMP-05	Chester Creek	20,600
Total Reduction Achieved				**378,225 lbs./yr.**
Required Reduction				**374,307 lbs./yr.**

BMP Selection Process

The results of the Mapshed model demonstrates that the majority of the sediment load generated within the Urbanized Area of West Goshen Township originates from streambank erosion. As such, BMPs including streambank stabilization, floodplain reconnection, and riparian buffer restoration were selected to address the instream erosion issues, in addition to land-based BMPs, such as bio-retention, and constructed wetlands. BMP locations came as a result of a feasibility investigation performed in the spring of 2015 in which representatives of West Goshen Township and HRG identified candidate BMP locations that offered the greatest potential for sediment load reduction in locations that the Township felt property owners would likely be cooperative. BMP location maps are included in Appendix B.

Proposed Streambank Stabilization, Velocity Reduction, and Buffer Restoration BMPs

Streambank stabilization prevents further erosion and degradation of disturbed or cut back streambanks, ultimately resulting in lower sediment and nutrient loads being released into the stream. Where practical, the Township will implement vegetative streambank stabilization to promote plant uptake of pollutant laden runoff in order to reduce the amount of nutrients and sediment eventually reaching the local waterways. Vegetative stabilization relies on the root structures of established plantings to stabilize the streambank and provide scour protection. In addition, incised streambanks will be regraded at a lesser slope to prevent further incision by allowing the stream to reconnect to the surrounding floodplain. This method offers a relatively inexpensive means of stabilization and provides a naturalized appearance to the rehabilitated streambank.

Velocity reduction, where practical, will be achieved through the use of rock vanes, wing deflectors, and grade controls in combination with streambank stabilization, riparian buffer projects, and floodplain reconnection. These instream structures will direct stream flow away from eroding or newly stabilized streambanks, as well as create stream meanders that will reduce stream velocity, further preventing streambank erosion and scour. The structures will be constructed of natural materials such as rock, root wads, and logs. The exact number and locations for the proposed instream structures will be determined upon approval of the Combined TMDL Plan during the completion of the engineered design.

West Goshen Township intends to perform riparian buffer restoration on the segments of stream to be stabilized. The goal of the riparian buffer projects is to naturalize the existing floodplain and reestablish buffer areas along the stream segments to a minimum width of 35 feet. The restorations will include the removal and replacement of dead, diseased, and/or invasive vegetation; as well as new plantings in areas where buffers have diminished in size. The riparian buffer restoration projects will be implemented concurrently with the stabilization projects in order to maximize the nutrient load reduction potential of each segment of stream to be enhanced, and will incorporated into the engineered design.

Proposed BMP-03 and a portion of BMP-04 will contribute to approximately 2,875 feet of restored stream and enhanced buffer in the Combined TMDL Planning Area, greatly reducing the amount of sedimentation due to instream erosion.

Detention Basin Retrofit

BMP-01 and BMP-02 are proposed detention basin retrofits. The existing basins serve as the main stormwater management facilities for two adjoining neighborhoods in northcentral portion of the Township. The existing basins offer no water quality benefits, other than minor settling, as they are simply detention, designed for rate control. BMP-04, adjacent to the West Chester Sports Center, also entails a large detention basin retrofit, along with the possibility to incorporate constructed wetlands into a smaller adjoining detention area. The project will be paired with a stream restoration project at the same location.

Detention basins are relatively simple basins designed to receive, temporarily hold, and discharge stormwater at a controlled rate. While they can provide rate and volume mitigation, detention basins offer limited water quality benefit. Detention basin retrofits transform these simple catch, store, and release ponds into BMPs which provide infiltration, bioretention, and improved sediment and nutrient removal capabilities. This is achieved by extending the storage time with structure modifications, improving soil conditions to allow for greater infiltration rates, and naturalizing the basins with native and/or wetland plant species.

West Goshen Township conducted a detention basin retrofit on a large basin in 2009. The basin, known as the Bicking Basin, serves as the main stormwater management facility for a large residential development in the southeast corner of the Township. Finding that the retrofitted basin produced substantial water quality and aesthetic value, the Township expressed interest in conducting more retrofits in order to achieve the sediment reduction requirements mandated by the TMDLs and PRPs. The Township is proposing to perform two additional detention basin retrofits at locations within the Combined TMDL Planning Area (Table 11). While the extent and nature of the retrofits will rely on the results of future engineering investigations, each basin retrofit will reduce the quantity and increase the quality of the stormwater runoff reaching the impaired streams. For modeling purposes, the fraction of area treated values for each retrofit were taken as a percentage of the basin's respective sewershed. The locations of the proposed detention basin retrofit projects are displayed on the location map in Appendix B.

Short-Term BMP Implementation Schedule

A preliminary implementation schedule has been provided (Table 12); however, construction of the proposed BMPs may rely on the results of the engineering investigation, design, and permitting process. The proposed stream restoration projects will likely require a Joint Permit Application (JPA) and will be subject to PADEP and United States Army Corps of Engineers (USACE) review. The Township recognizes their ability to review and revise their Short-term sediment reduction strategy and may elect to do so in accordance with PADEP regulations. Any revisions to the Combined TMDL Plan will be appropriately reported to all applicable regulatory agencies.

Table 12: Implementation Schedule for Proposed Short-term BMPs

BMP Type	Location (Lat. / Long.)	Map Reference	Permitting & Engineering Design (Permit Year)	Construction (Permit Year)
Hamilton Drive Detention Basin Retrofit	39.995733° , -75.611727°	BMP-01	1	2
Farren Drive Detention Basin Retrofit	39.998006° , -75.612304°	BMP-02	1	2
Hagerty Lane Stream Restoration	39.948947° , -75.581787°	BMP-03	2	3
Westtown Road Stream Restoration	39.958095°, -75.584041°	BMP-04	3	4-5
Westtown Road Detention Basin Retrofits & Constructed Wetlands	39.958095°, -75.584041°	BMP-05	3	4-5

2. Long-Term Reductions to Meet WLA(s):

As previously stated, West Goshen Township intends to achieve the required long-term pollutant load reduction goals prescribed by the WLAs included in the EPA's Goose Creek Watershed and Christina River Basin TMDL Reports through continued implementation of the pollutant load reducing BMPs and educational activities over several future MS4 Permit terms. The Township will continue to implement pollutant reducing BMPs in order to achieve the required pollutant reductions necessary to the WLAs for both the Goose Creek Watershed and the Christina River Basin Watershed. West Goshen Township submitted a MS4 TMDL Strategy for both impaired watersheds in 2015, in which the Township identified numerous potential projects that upon successful construction, could achieve each impaired watershed's respective WLA. The Township will continue to use the original strategies as a source of identifying future project locations, and will recalculate the pollutant load reductions associated with each project based on the latest PADEP-approved pollutant removal efficiencies.

Table 13: Long-Term Pollutant Load Reduction (Appendix F)

Watershed	Impairment	Short-term Load Reduction (lbs./yr.)	Short-term Load Reduction (%)	Long-Term Load Reduction Goal	Remaining Reduction Required (lbs./yr.)
Christina River Basin	TSS	217,368	26%.	504,233.5	286,865.9
Goose Creek Watershed	TP	62.8 ***	5%	581.2 lbs./yr.	518.4

***Based on correlation made under "Presumptive Approach," 10% TSS reduction equivalent to 5% reduction in TP.

Based on the Short-term pollutant loads expected to be achieved during the first permit term (Table 12), a preliminary timeframe of when the Township could likely meet the required long-term pollutant reductions of the TMDLs can be projected. Pending future guidance by PADEP, the Township will continue forward with the goal of achieving pollutant load reductions similar to those proposed for the first permit term as described under the Short-term Pollutant goals. At the continued pace of the Short-term pollutant load reduction goals, the Township will look to achieve the 60.87% sediment load reduction for the Christina River Basin upon completion of the third 5-year permit term. The more difficult to achieve 53.9% reduction of total phosphorus may be achieved by the end of the sixth 5-year permit term.

Section H: Funding Mechanisms

The design and construction of the BMPs proposed herein will be funded through a variety of sources including collected stormwater fees, Township general funds, available grants, and public donation of materials and manpower. The proposed forest buffer projects may be constructed, at least in part, by Township staff and/or civic and volunteer groups in order to lessen the overall cost of implementing the Combined TMDL Plan.

Section I: Operation & Maintenance (O&M)

O&M requirements for the streambank stabilization and buffer restoration projects shall include:

- Ensure disturbed areas are kept free of foot and/or vehicular traffic until full stabilization has occurred – year round
- Regular watering of plantings during first growing season. Planting in the fall may reduce the need for additional watering - seasonally
- Conduct site visits to ensure plantings are healthy and sufficiently watered, weeds are properly managed, sufficient mulch is in place until site is stabilized and planting have become established - monthly
- Conduct site visits to ensure all disturbed earth remains stabilized and erosion or cutting of the streambank has not taken place. Any destabilized earth or active streambank erosion shall be repaired immediately upon discovery - monthly
- Conduct inspections once streambank is stabilized and plants have become established - biannually
- Immediately upon notice; repair any rills, gullies, or streambank cutting that may occur – year round
- Remove weeds and invasive plant species during each growing season. Naturally growing native vegetation should be left intact to promoted stabilization of the streambank and surrounding area - seasonally
- Replace mulch as needed - biannually
- Remove accumulated trash and debris - monthly
- Remove and replace dead and diseased plantings - biannually
- Keep machinery and vehicles away from stabilized areas – year round

O&M requirements for the retrofit bio-retention basins shall continue to include**:**

- Conduct regular inspections until site is stabilized and plantings are established -monthly
- Immediately upon notice, repair and erosion issues in the basin – year round
- Remove and replace dead of diseased plantings - biannually
- Remove weeds and invasive species from the basin - quarterly
- Remove accumulated sediment and debris - monthly
- Mulch as necessary – biannually
- Use no chemical herbicides or pesticides – year round
- Maintain a "No Mow Zone" around the perimeter of the basin – year round
- Ensure outlet structures remain unobstructed and free of debris - monthly

The contractor shall be responsible for the operation and maintenance of the streambank restoration and buffer project(s) until all features of the project have been successfully constructed to the specifications and design standards set forth by the Township Engineer. The Contractor shall remain responsible for operation and maintenance of the streambank restoration and buffer project(s) until 70% permanent vegetative stabilization has been achieved. Once construction of the project(s) is complete and stabilization has occurred, the Township shall be responsible for implementing all Operation and Maintenance procedures

to ensure the streambank stabilization and buffer improvements remained operationally functional and physically consistent with the original design.

APPENDIX A

APPENDIX B

Combined TMDL Planning Area

West Goshen Township
Chester County, Pennsylvania

850 0 850 Feet

Mapping derived from data provided by Chester County, PennDOT, US Census, and USGS.

7/19/2017	PM: EGL	GIS: BLS	QA: EGL	R004194.0430

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- Existing BMP
- Proposed BMP
- Proposed Approximate Length of Stream In Project
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- Storm Inlet
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- Municipal Property
- Municipal Boundary
- Urbanized Area (2010)
- Watershed Boundary

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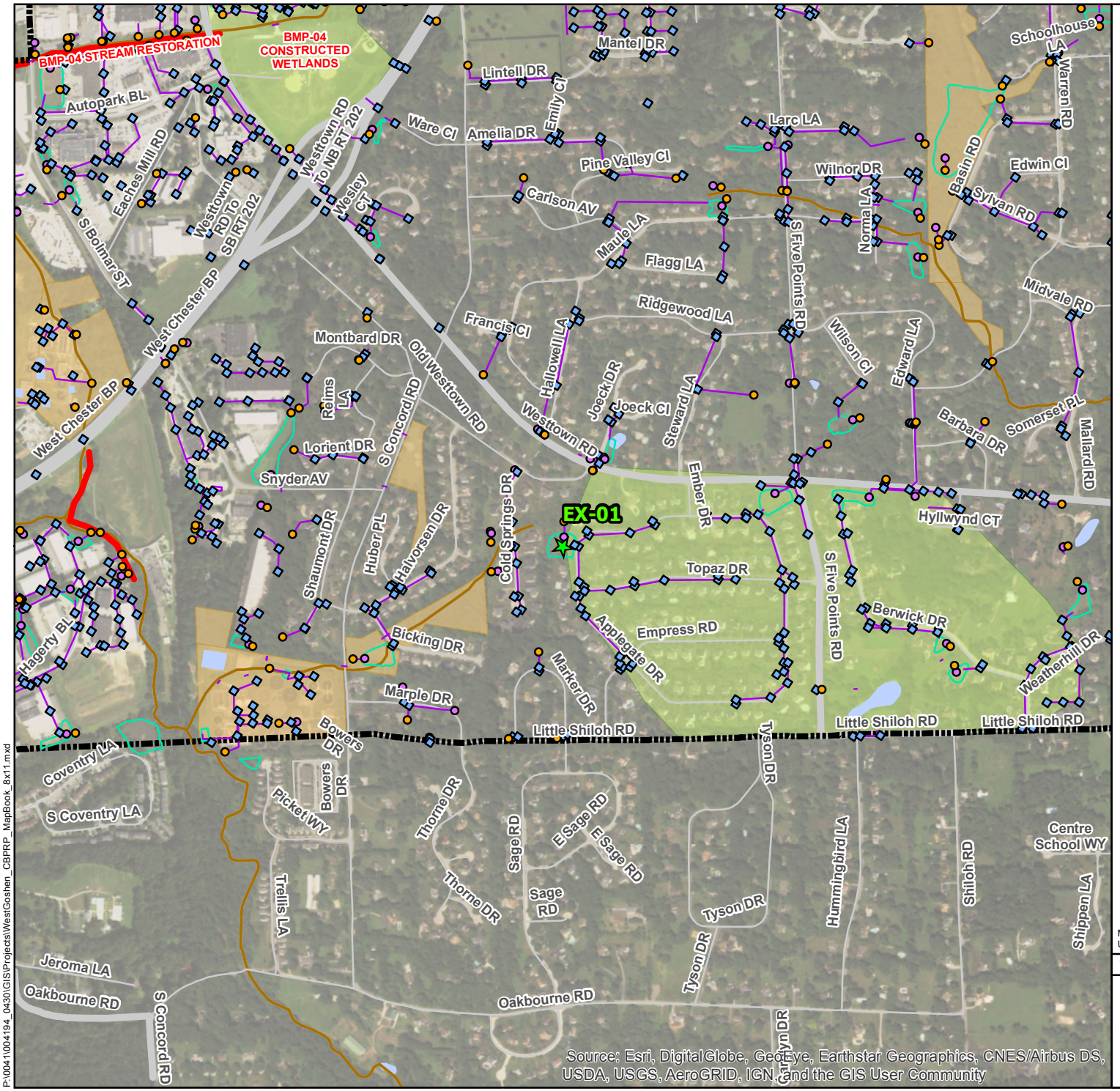

Existing BMP EX-01

West Goshen Township
Chester County, Pennsylvania

- Existing BMP
- Proposed Approximate Length of Stream In Project
- Storm Outfall
- Storm Inlet
- Storm Basin Outfall
- Storm Gravity Main
- Storm Basin
- Sediment Impaired Stream
- Local Road
- State Road
- BMP Drainage Area
- Municipal Property
- Municipal Boundary
- Watershed Boundary

0 1,000 Feet

Mapping derived from data provided by Chester County, USGS, US Census, and ESRI.

7/19/2017	PM: EGL	GIS: BLS	QA: EGL	R004194.0431

HRG
Herbert, Rowland & Grubic, Inc.
Engineering & Related Services
An Employee-Owned Company

369 East Park Drive
Harrisburg, PA 17111
717.564.1121 [phone]
717.564.1158 [fax]
www.hrg-inc.com

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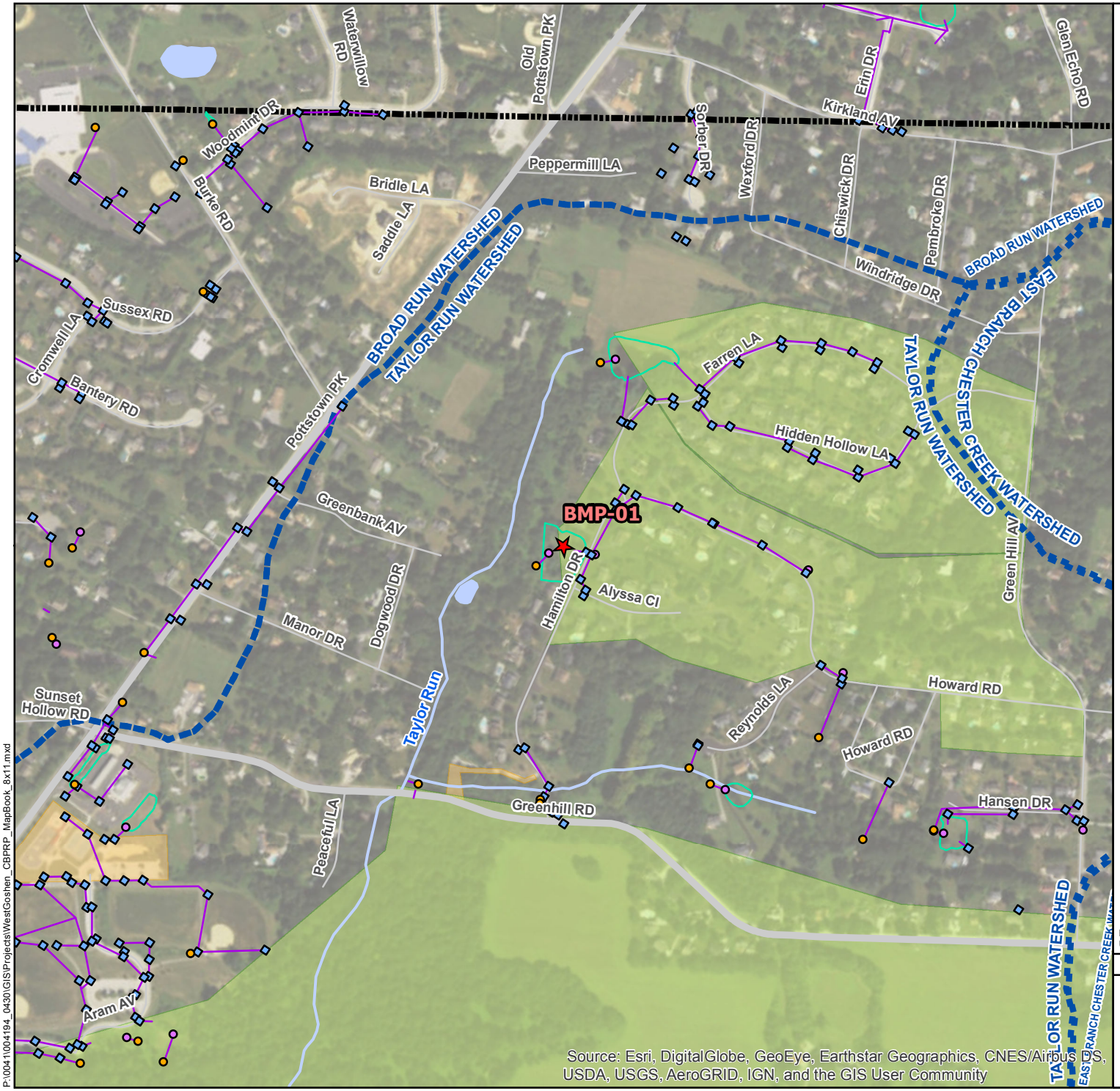

Proposed BMP
BMP-01

West Goshen Township
Chester County, Pennsylvania

- Proposed BMP
- Storm Outfall
- Storm Inlet
- Storm Basin Outfall
- Storm Gravity Main
- Storm Basin
- Local Road
- State Road
- BMP Drainage Area
- Municipal Property
- Municipal Boundary
- Watershed Boundary

0 600 Feet

Mapping derived from data provided by Chester County, USGS, US Census, and ESRI.

7/19/2017	PM: EGL	GIS: BLS	QA: EGL	R004194.0431

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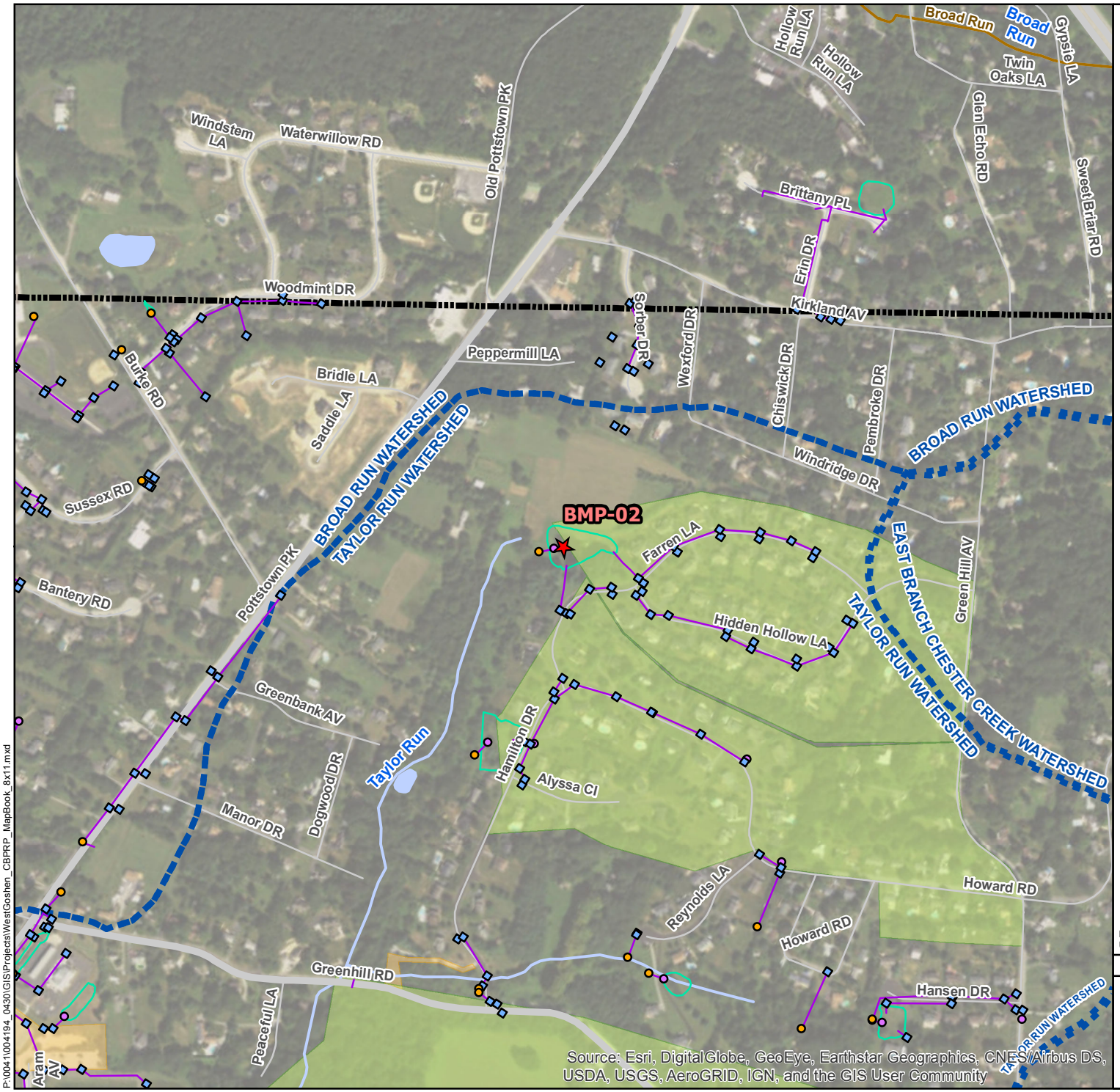

Proposed BMP
BMP-02

West Goshen Township
Chester County, Pennsylvania

- Proposed BMP
- Storm Outfall
- Storm Inlet
- Storm Basin Outfall
- Storm Gravity Main
- Storm Basin
- Sediment Impaired Stream
- Local Road
- State Road
- BMP Drainage Area
- Municipal Property
- Municipal Boundary
- Watershed Boundary

0 600 Feet

Mapping derived from data provided by Chester County, USGS, US Census, and ESRI.

7/19/2017	PM: EGL	GIS: BLS	QA: EGL	R004194.0431

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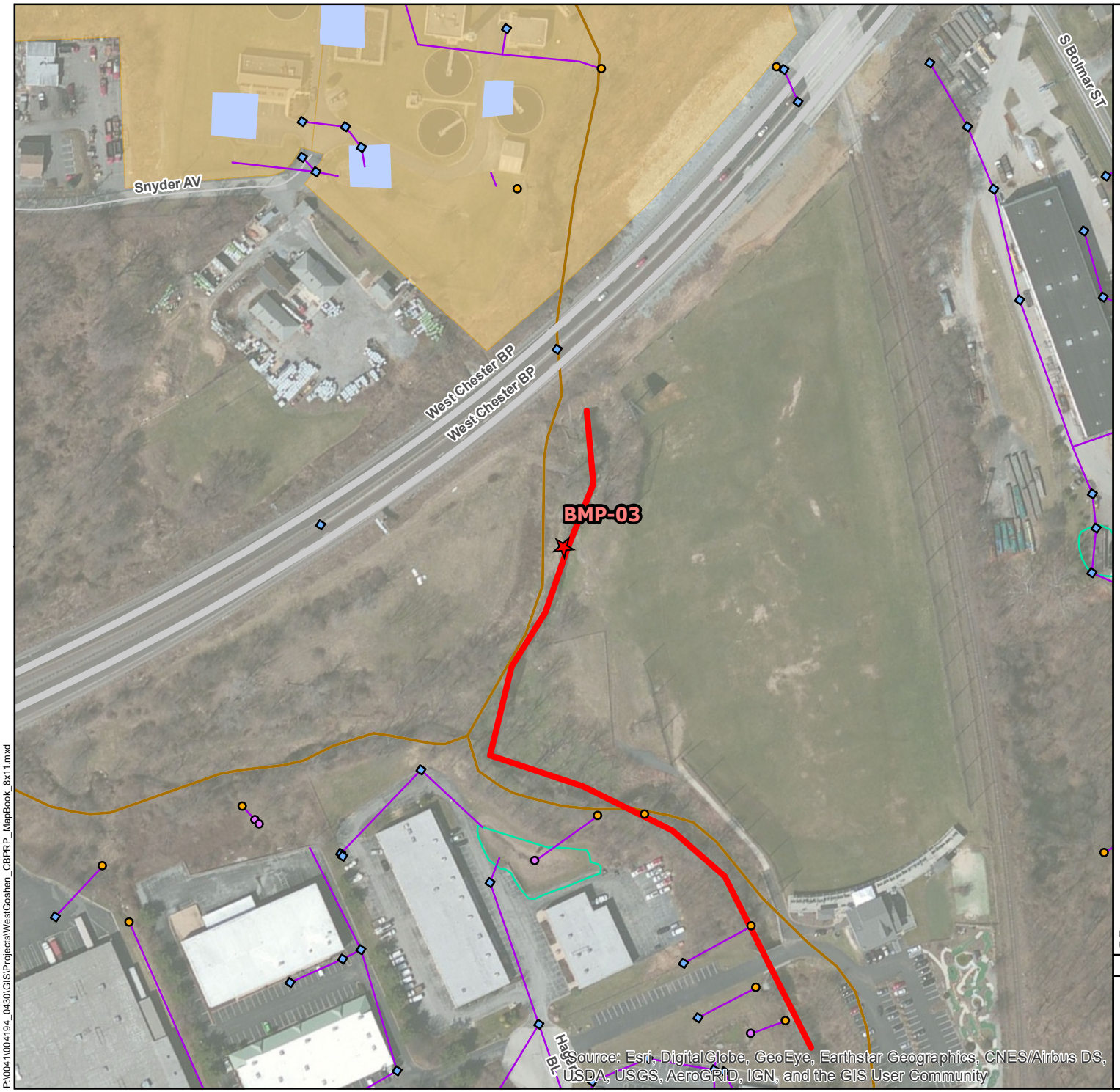

Proposed BMP
BMP-03

West Goshen Township
Chester County, Pennsylvania

- Proposed BMP
- Proposed Approximate Length of Stream In Project
- Storm Outfall
- Storm Inlet
- Storm Basin Outfall
- Storm Gravity Main
- Storm Basin
- Sediment Impaired Stream
- Local Road
- State Road
- Municipal Property
- Municipal Boundary
- Watershed Boundary

0 200 Feet

Mapping derived from data provided by Chester County, USGS, US Census, and ESRI.

7/19/2017	PM: EGL	GIS: BLS	QA: EGL	R004194.0431

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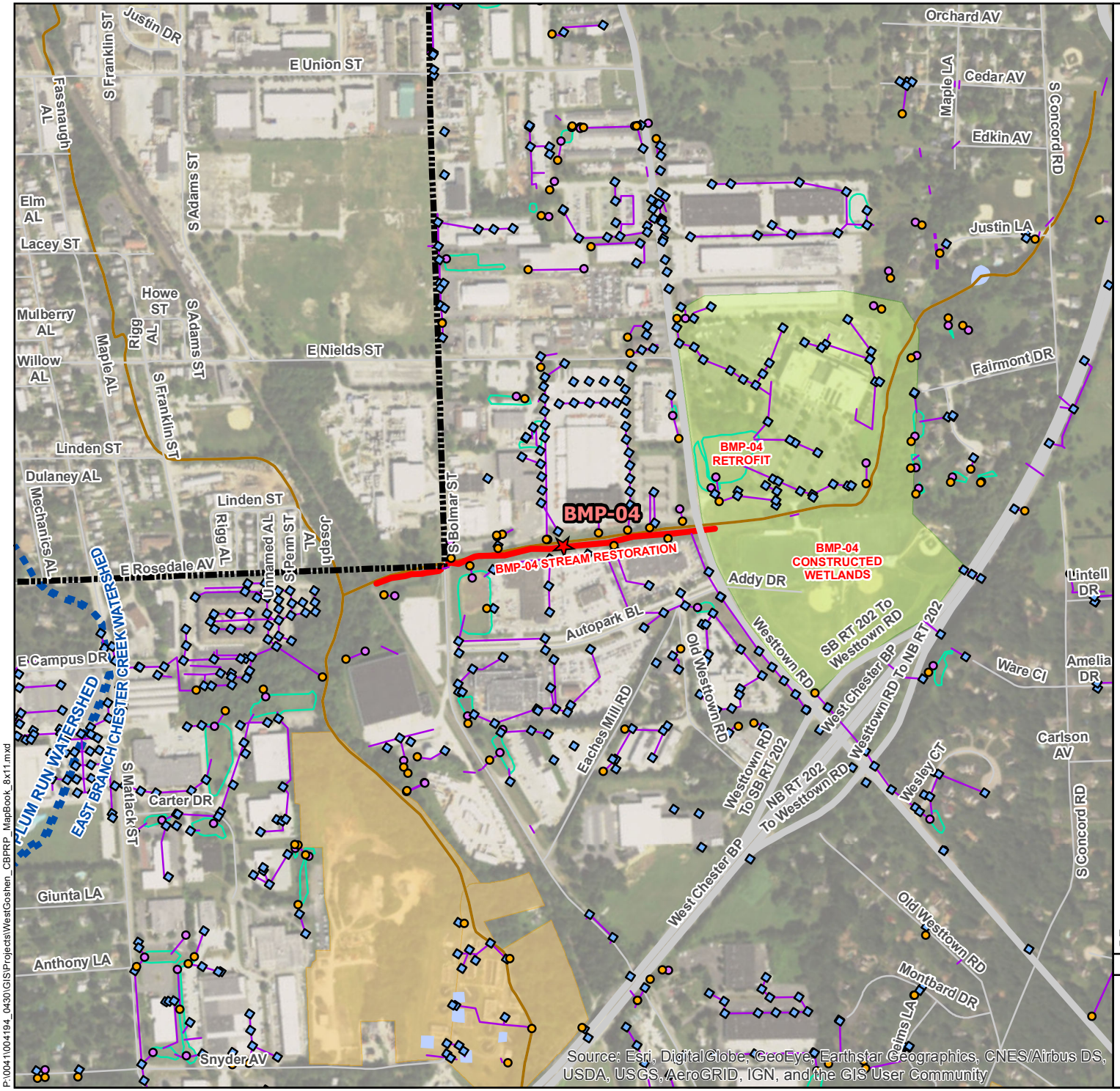

Proposed BMP
BMP-04

West Goshen Township
Chester County, Pennsylvania

- Proposed BMP
- Proposed Approximate Length of Stream In Project
- Storm Outfall
- Storm Inlet
- Storm Basin Outfall
- Storm Gravity Main
- Storm Basin
- Sediment Impaired Stream
- Local Road
- State Road
- BMP Drainage Area
- Municipal Property
- Municipal Boundary
- Watershed Boundary

0 710 Feet

Mapping derived from data provided by Chester County, USGS, US Census, and ESRI.

7/19/2017	PM: EGL	GIS: BLS	QA: EGL	R004194.0431

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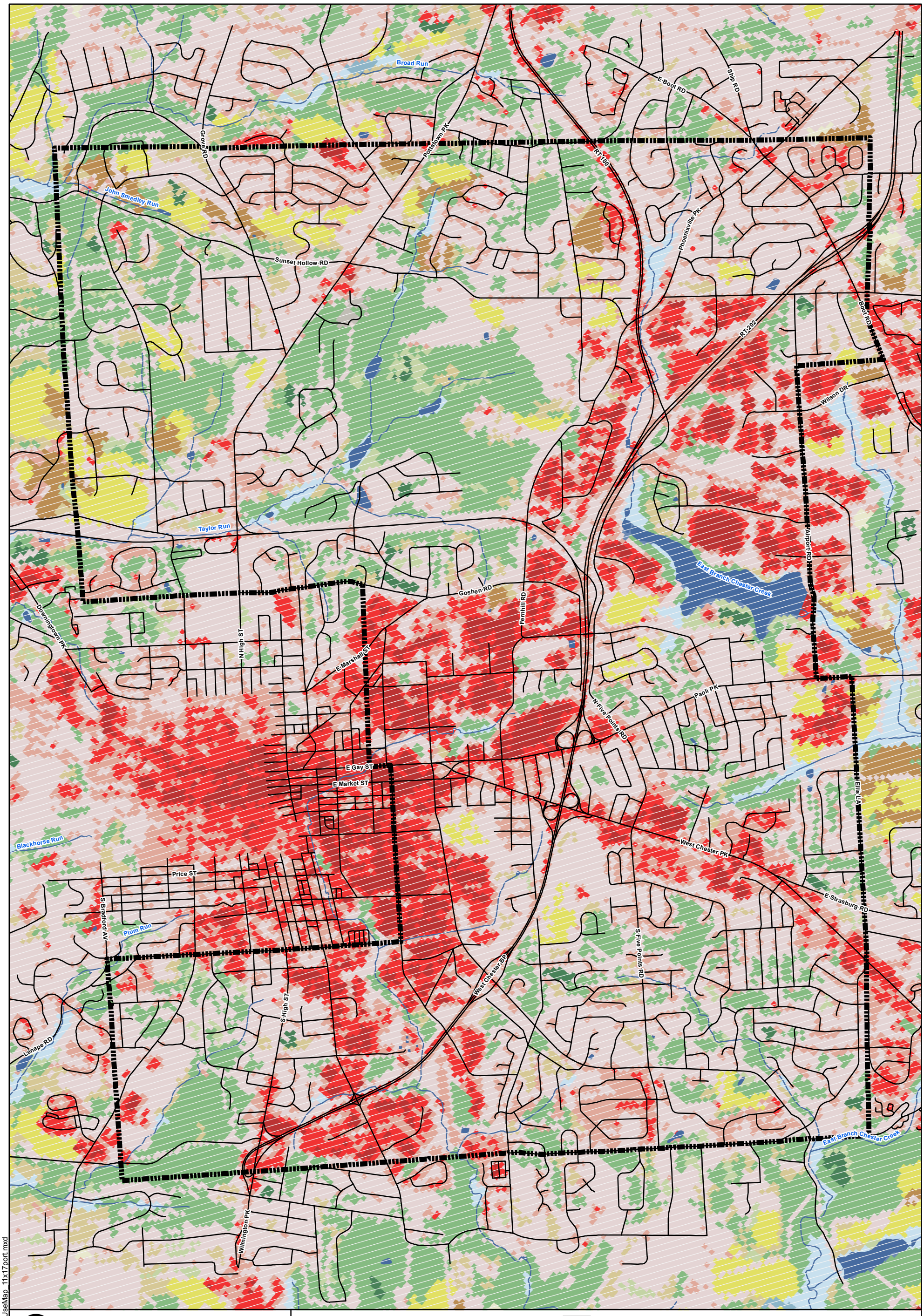

2,000 0 2,000 Feet

Mapping derived from data provided by Chester County, USGS, US Census, and MRLC.

5/5/2017	PM: EGL	GIS: BLS/ HMG	QA: HSH	R004194.0430

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- Road
- Municipal Boundary
- Open Water
- Developed, Open Space
- Developed, Low Intensity
- Developed, Medium Intensity
- Developed, High Intensity
- Barren Land (Rock/Sand/Clay)
- Deciduous Forest
- Evergreen Forest
- Mixed Forest
- Shrub/Scrub
- Grassland/Herbaceous
- Pasture/Hay
- Cultivated Crops
- Woody Wetlands
- Emergent Herbaceous Wetlands
- Urban Areas (2010)

Land Use Map

West Goshen Township
Chester County, Pennsylvania

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APPENDIX C

MS4 Name	Permit Number	HUC 12 Name	Impaired Downstream Waters or Applicable TMDL Name	Requirement(s)
Chester County				
WEST BRADFORD TWP	PAI130511	Lower West Branch Brandywine Creek, Upper West Branch Brandywine Creek	Christina River Basin Nutrients, Christina River Basin Sediment	TMDL Plan-Nutrients, Organic Enrichment/Low D.O., Siltation, Suspended Solids
		Upper West Branch Brandywine Creek	West Branch Brandywine Creek	Appendix C-PCB
		Beaver Creek, Lower East Branch Brandywine Creek	Christina River Basin Nutrients, Christina River Basin Sediment	TMDL Plan-Nutrients, Organic Enrichment/Low D.O., Siltation, Suspended Solids
		Upper Brandywine Creek	Christina River Basin Nutrients, Christina River Basin Sediment	TMDL Plan-Nutrients, Organic Enrichment/Low D.O., Siltation, Suspended Solids
WEST BRANDYWINE TWP	PAI130544	Upper West Branch Brandywine Creek	Christina River Basin Nutrients, West Branch Brandywine Creek	Appendix C-PCB, Appendix E-Siltation, TMDL Plan-Nutrients, Organic Enrichment/Low D.O.
		Upper East Branch Brandywine Creek	Culbertson Run	Appendix E-Siltation
		Beaver Creek, Lower East Branch Brandywine Creek, Upper East Branch Brandywine Creek	Christina River Basin Nutrients	TMDL Plan-Nutrients, Organic Enrichment/Low D.O.
WEST CALN TWP	PAG130145	Upper West Branch Brandywine Creek	Christina River Basin Nutrients, Christina River Basin Sediment, West Branch Brandywine Creek	Appendix C-PCB, TMDL Plan-Nutrients, Organic Enrichment/Low D.O., Siltation, Suspended Solids
		Headwaters Pequea Creek	Chesapeake Bay Nutrients\Sediment, Indian Spring Run, Pequea Creek	Appendix D-Siltation/Nutrients, Appendix E-Nutrients, Organic Enrichment/Low D.O., Siltation
WEST CHESTER BORO	PAG130002	Lower East Branch Brandywine Creek	Blackhorse Run, Taylor Run	Appendix E-Siltation
		Upper Brandywine Creek	Brandywine Creek, Plum Run	Appendix E-Siltation
		Chester Creek	Chester Creek, Goose Creek TMDL	Appendix B-Pathogens, Appendix E-Siltation, TMDL Plan-Nutrients
WEST GOSHEN TWP	PAI130532	Middle Brandywine Creek, Upper Brandywine Creek	Christina River Basin Sediment	TMDL Plan-Nutrients, Siltation, Suspended Solids
		Chester Creek	Chester Creek, Goose Creek TMDL	Appendix B-Pathogens, TMDL Plan-Nutrients, Siltation, Suspended Solids
		Lower East Branch Brandywine Creek, Valley Creek	Christina River Basin Sediment	TMDL Plan-Nutrients, Siltation, Suspended Solids
		Chester Creek, East Branch Chester Creek	Chester Creek, East Branch Chester Creek	Appendix E-Siltation
WEST GROVE BORO	PAG130144	East Branch White Clay Creek, Middle Branch White Clay Creek, Upper White Clay Creek	Christina River Basin Nutrients, Christina River Basin Sediment, East Branch White Clay Creek, Middle Branch White Clay Creek	Appendix B-Pathogens, TMDL Plan-Nutrients, Organic Enrichment/Low D.O., Siltation, Suspended Solids
WEST NOTTINGHAM TWP		North East Creek	Chesapeake Bay Nutrients\Sediment, North East Creek	Appendix D-Siltation/Nutrients, Appendix E-Siltation
		Basin Run-Octoraro Creek, Tweed Creek-Octoraro Creek	Chesapeake Bay Nutrients\Sediment	Appendix D-Siltation/Nutrients
WEST PIKELAND TWP	PAI130531	Pickering Creek	Pickering Creek	Appendix B-Pathogens
WEST SADSBURY TWP	PAG130170	Muddy Run-East Branch Octoraro Creek, Pine Creek, Valley Creek-East Branch Octoraro Creek	Chesapeake Bay Nutrients\Sediment, East Branch Octoraro Creek, Pine Creek, Unnamed Tributaries to East Branch Octoraro Creek, Valley Creek	Appendix D-Siltation/Nutrients, Appendix E-Nutrients, Siltation

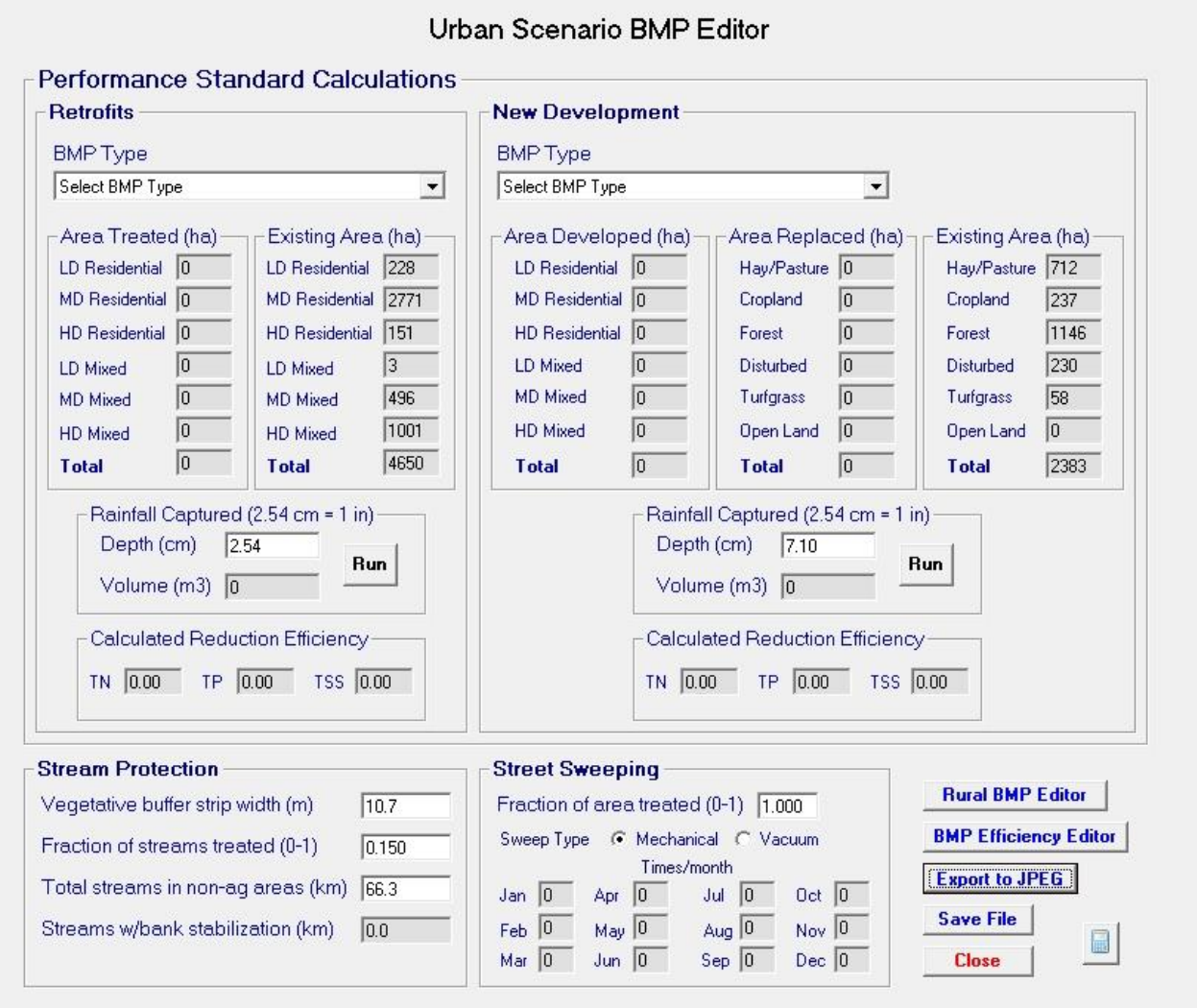
MS4 Name	NPDES ID	Individual Permit Required?	Reason	Impaired Downstream Waters or Applicable TMDL Name	Requirement(s)	Other Cause(s) of Impairment
Chester County						
WEST BRANDYWINE TWP	PAI130544	Yes	TMDL Plan, SP, IP	West Branch Brandywine Creek	Appendix C-PCB (4a), Appendix E-Siltation (4a)	Water/Flow Variability (4c)
				Beaver Creek		Cause Unknown (4a), Other Habitat Alterations, Water/Flow Variability (4c)
				Christina River Basin Nutrients	TMDL Plan-Nutrients, Organic Enrichment/Low D.O. (4a)	
				Culbertson Run	Appendix E-Siltation (4a)	Other Habitat Alterations (4c)
				Unnamed Tributaries to West Branch Brandywine Creek		Cause Unknown (4a)
				East Branch Brandywine Creek		Cause Unknown (4a), Other Habitat Alterations, Water/Flow Variability (4c)
WEST CALN TWP	PAG130145	Yes	TMDL Plan, SP	Christina River Basin Nutrients	TMDL Plan-Nutrients, Organic Enrichment/Low D.O. (4a)	
				Chesapeake Bay Nutrients/Sediment	Appendix D-Nutrients, Siltation (4a)	
				Christina River Basin Sediment	TMDL Plan-Siltation, Suspended Solids (4a)	
				Indian Spring Run	Appendix E-Nutrients, Organic Enrichment/Low D.O., Siltation (4a)	
				Pequea Creek	Appendix E-Nutrients, Organic Enrichment/Low D.O., Siltation (4a)	
				West Branch Brandywine Creek	Appendix C-PCB (4a)	Water/Flow Variability (4c)
WEST CHESTER BORO	PAG130002	Yes	TMDL Plan	Taylor Run	Appendix E-Siltation (4a)	Cause Unknown (4a), Other Habitat Alterations (4c)
				Plum Run	Appendix E-Siltation (4a)	Water/Flow Variability (4c)
				Goose Creek TMDL	TMDL Plan-Nutrients (4a)	Cause Unknown (4a)
				Chester Creek	Appendix B-Pathogens (5), Appendix E-Siltation (5)	Cause Unknown (5), Flow Alterations, Water/Flow Variability (4c)
				Brandywine Creek	Appendix E-Siltation (4a)	
				Blackhorse Run	Appendix E-Siltation (4a)	Other Habitat Alterations, Water/Flow Variability (4c)
WEST GOSHEN TWP	PAI130532	Yes	TMDL Plan, SP, IP	East Branch Chester Creek	Appendix E-Siltation (5)	Cause Unknown (5), Other Habitat Alterations, Water/Flow Variability (4c)
				Broad Run		Water/Flow Variability (4c)
				Chester Creek	Appendix B-Pathogens (5), Appendix E-Siltation (5)	Cause Unknown (5), Flow Alterations, Water/Flow Variability (4c)
				East Branch Brandywine Creek		Cause Unknown (4a), Water/Flow Variability (4c)
				Goose Creek TMDL	TMDL Plan-Nutrients (4a)	Cause Unknown (4a)
				John Smedley Run		Water/Flow Variability (4c)
				Plum Run		Water/Flow Variability (4c)
				Taylor Run		Cause Unknown (4a), Other Habitat Alterations (4c)
				Christina River Basin Sediment	TMDL Plan-Siltation, Suspended Solids (4a)	

APPENDIX D

PAI30532 - West Goshen Township Parsed Areas

No.	Location	Permit Type	Permit Number	Lot Size (Acre)	Lot Size (Hectare)	Parcel ID	Address	Land Use	Watershed
1	Schramm Inc.	PAG-03	PAR110059	26.1	10.6	52-5-5	800 E VIRGINIA AVE WEST CHESTER, PA 19380	Hi Density - Mix	Goose Creek
2	Trans Materials Inc.	PAG-03	PA54747	14.2	5.75	52-5-8	831 LINCOLN AVE WEST CHESTER, PA 19380	Hi Density - Mix	Christina River
3	Portescap West Chester Plt	PAG-03	PAR110057	3.3	1.34	52-5F-90	110 WESTTOWN RD WEST CHESTER, PA 19382	Hi Density - Mix	Goose Creek
4	A Duie Pyle West Chester Facility	PAG-03	PAR800164	21.8	8.82	52-5-156.3	650 WESTTOWN RD WEST CHESTER, PA 19382	Hi Density - Mix	Goose Creek
5	A Duie Pyle Bolmar Street Facility	PAG-03	PAG030034	19	7.69	52-5-205	830 S BOLMAR ST WEST CHESTER, PA 19382	Hi Density - Mix	Goose Creek
6	Rusmar Inc.	PAG-03	PAG030036	6	2.43	52-5B-2	216 GARFIELD AVE WEST CHESTER, PA 19380	Hi Density - Mix	Goose Creek
7	Safety Kleen West Chester Facility	PAG-03	PAR600058	4.7	1.90	52-3-101	1140-42 GREENHILL RD WEST CHESTER, PA 19380-4053	Hi Density - Mix	Christina River
8	Metallurgical Prod Co.	PAG-03	PAR200009	5.1	2.06	52-5-32	810 Lincoln Ave. WEST CHESTER, PA 19380	Hi Density - Mix	Goose Creek
9	Eldredge Inc.	PAG-03	PAR800042	2	0.81	52-3-171.3	898 Fern Hill Road WEST CHESTER, PA 19380	Hi Density - Mix	Goose Creek
10	Hain Celestial	PAG-03	PAR120010	9.7	3.93	52-3-173.6	700 Old Fern Hill Road WEST CHESTER, PA 19380	Hi Density - Mix	Goose Creek
11	Con-Way Freight	PAG-03	PAR80086	5	2.02	52-5F-6	206 Garfield Ave. WEST CHESTER, PA 19381	Hi Density - Mix	Goose Creek

Baseline Pollutant Load – MapShed Baseline Load Input Exhibit



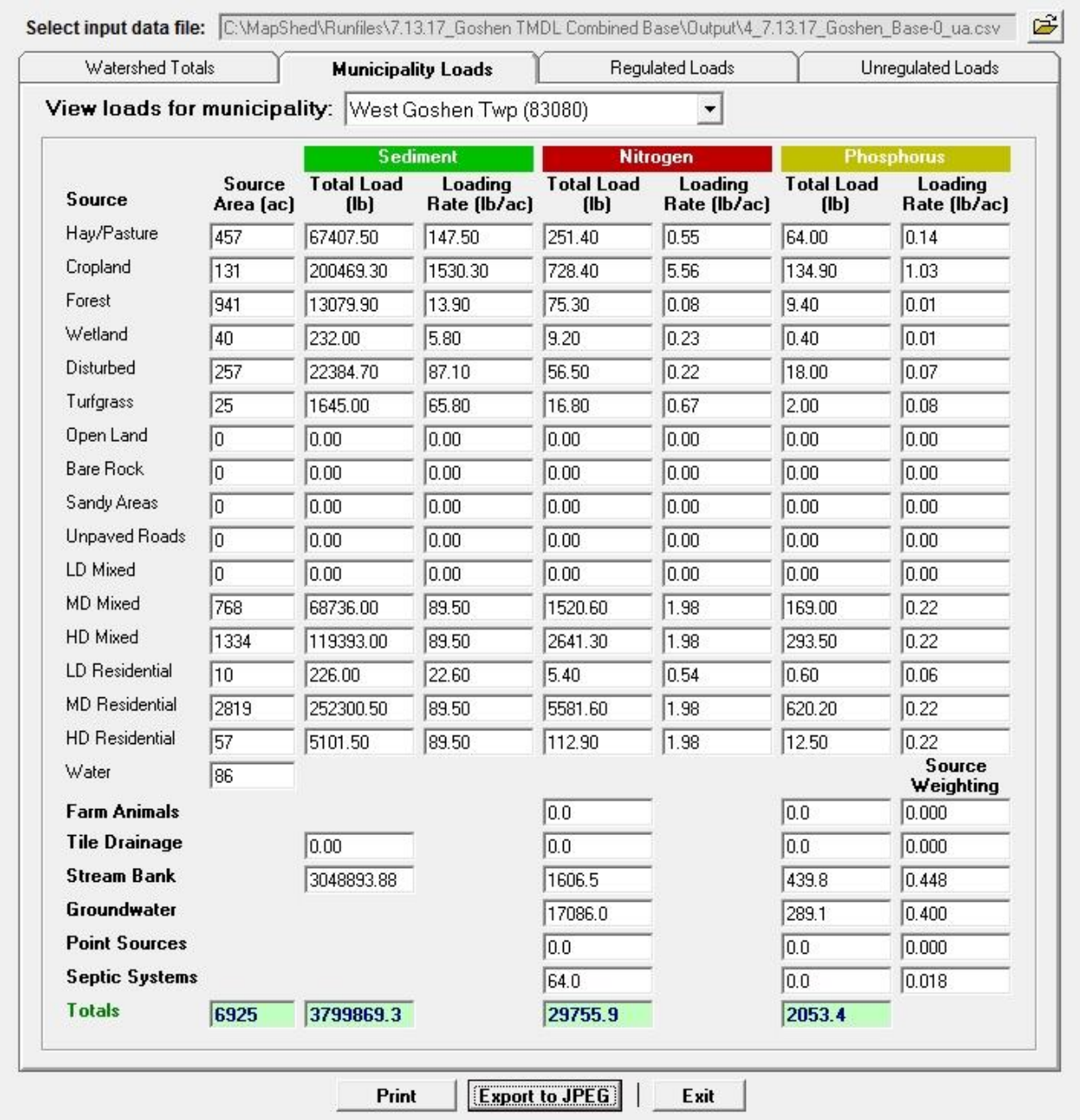
Baseline Modeled Area Pollutant Load – MapShed Baseline Pollutant Loads by Source for Entire Modeled Area

GWLF Total Loads for file: 4_7.13.17_Goshen_Base-0 **Period of analysis:** 17 years from 1975 to 1991

Source	Area (Acres)	Runoff (in)	Tons		Total Loads (Pounds)			
			Erosion	Sediment	Dissolved N	Total N	Dissolved P	Total P
Hay/Pasture	1759	1.4	1094.2	129.8	428.4	975.2	103.5	253.2
Cropland	586	3.6	3780.9	448.4	1367.5	3257.0	85.5	602.6
Forest	2832	1.1	165.8	19.7	136.4	219.3	7.1	29.8
Wetland	210	5.2	5.1	0.6	46.4	48.9	2.4	3.1
Disturbed	568	7.6	208.6	24.7	19.3	123.6	9.5	38.1
Turfgrass	143	0.9	39.7	4.7	76.5	96.4	5.5	11.0
Open Land	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bare Rock	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sandy Areas	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Unpaved Roads	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LD Mixed	7	4.3	0.0	0.1	1.1	4.0	0.2	0.4
MD Mixed	1226	11.9	0.0	54.8	740.1	2429.3	104.9	273.6
HD Mixed	2474	16.9	0.0	110.7	1493.7	4902.7	211.8	552.2
LD Residential	563	4.3	0.0	6.3	85.0	303.0	12.0	32.3
MD Residential	6847	7.2	0.0	306.4	4134.9	13571.9	586.3	1528.6
HD Residential	373	10.0	0.0	16.7	225.3	739.6	31.9	83.3
Farm Animals						0.0		0.0
Tile Drainage				0.0		0.0		0.0
Stream Bank				3698.8		3897.8		1067.0
Groundwater					42715.0	42715.0	722.8	722.8
Point Sources					0.0	0.0	0.0	0.0
Septic Systems					3557.8	3557.8	0.0	0.0
Totals	17588.9	7.10	5294.3	4821.7	55027.5	76841.5	1883.4	5198.0

Go Back | Pathogen Loads | Export to JPEG | Print | Close

<u>Baseline Combined TMDL Planning Area Pollutant Load</u> - MapShed Baseline Load Calculation Results for Planning Area



Select input data file: C:\MapShed\Runfiles\7.13.17_Goshen TMDL Combined Base\Output\4_7.13.17_Goshen_Base-0_ua.csv

Watershed Totals | **Municipality Loads** | Regulated Loads | Unregulated Loads

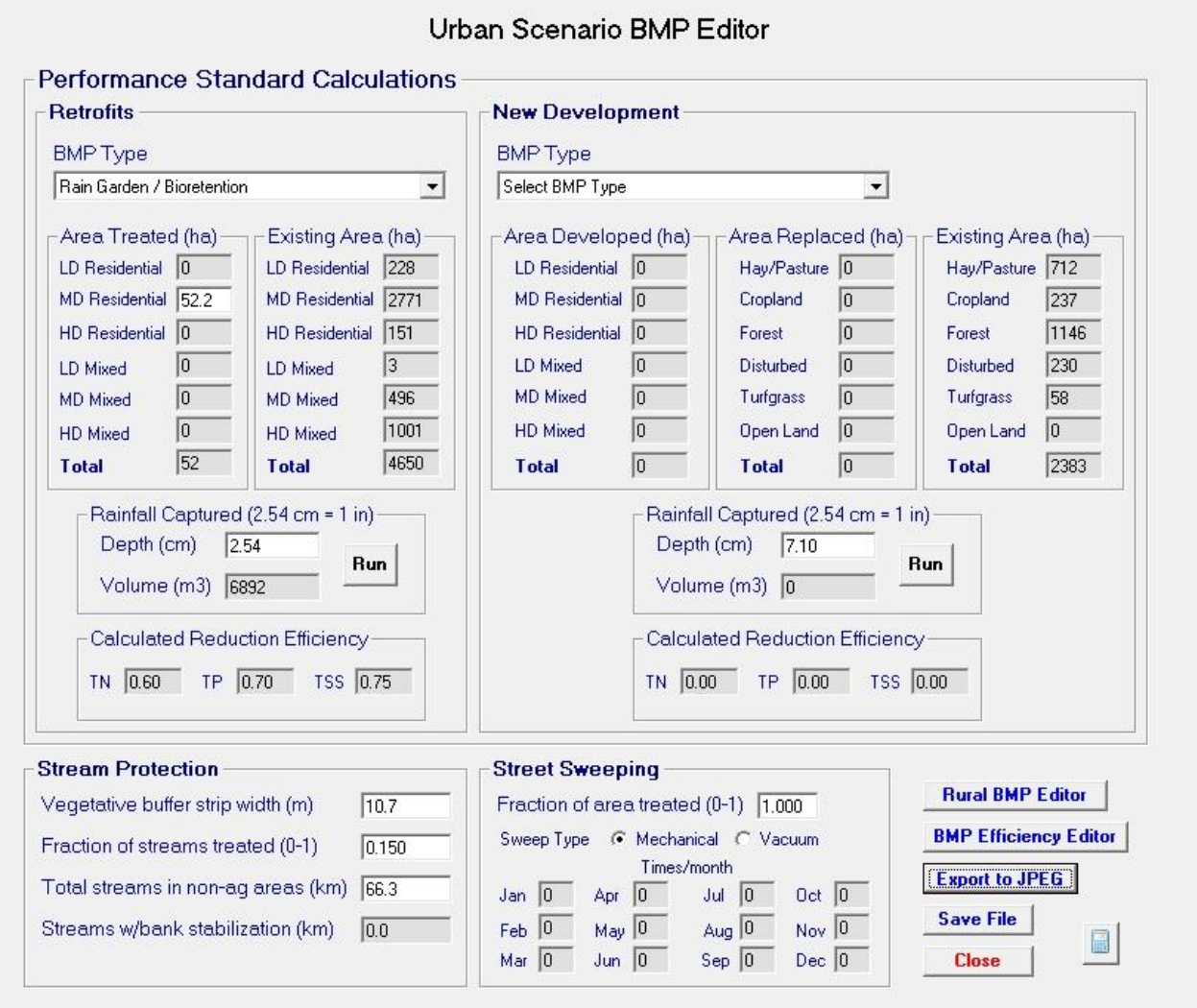
View loads for municipality: West Goshen Twp (83080)

Source	Source Area (ac)	Sediment Total Load (lb)	Sediment Loading Rate (lb/ac)	Nitrogen Total Load (lb)	Nitrogen Loading Rate (lb/ac)	Phosphorus Total Load (lb)	Phosphorus Loading Rate (lb/ac)
Hay/Pasture	457	67407.50	147.50	251.40	0.55	64.00	0.14
Cropland	131	200469.30	1530.30	728.40	5.56	134.90	1.03
Forest	941	13079.90	13.90	75.30	0.08	9.40	0.01
Wetland	40	232.00	5.80	9.20	0.23	0.40	0.01
Disturbed	257	22384.70	87.10	56.50	0.22	18.00	0.07
Turfgrass	25	1645.00	65.80	16.80	0.67	2.00	0.08
Open Land	0	0.00	0.00	0.00	0.00	0.00	0.00
Bare Rock	0	0.00	0.00	0.00	0.00	0.00	0.00
Sandy Areas	0	0.00	0.00	0.00	0.00	0.00	0.00
Unpaved Roads	0	0.00	0.00	0.00	0.00	0.00	0.00
LD Mixed	0	0.00	0.00	0.00	0.00	0.00	0.00
MD Mixed	768	68736.00	89.50	1520.60	1.98	169.00	0.22
HD Mixed	1334	119393.00	89.50	2641.30	1.98	293.50	0.22
LD Residential	10	226.00	22.60	5.40	0.54	0.60	0.06
MD Residential	2819	252300.50	89.50	5581.60	1.98	620.20	0.22
HD Residential	57	5101.50	89.50	112.90	1.98	12.50	0.22
Water	86						Source Weighting
Farm Animals				0.0		0.0	0.000
Tile Drainage		0.00		0.0		0.0	0.000
Stream Bank		3048893.88		1606.5		439.8	0.448
Groundwater				17086.0		289.1	0.400
Point Sources				0.0		0.0	0.000
Septic Systems				64.0		0.0	0.018
Totals	6925	3799869.3		29755.9		2053.4	

Print | Export to JPEG | Exit

Combined TMDL Planning Area Baseline Sediment Load = 3,799,869.3 pounds per year

Existing BMP, EX - 01 Pollutant Reduction - MapShed EX-01 BMP Input Exhibit



<u>EX-01 Pollutant Reduction</u> – MapShed Pollutant Loads by Source for Entire Modeled Area w/ EX-01

GWLF Total Loads for file: 5_7.13.17_Goshen_Base-0 **Period of analysis:** 17 years from 1975 to 1991

Source	Area (Acres)	Runoff (in)	Tons		Total Loads (Pounds)			
			Erosion	Sediment	Dissolved N	Total N	Dissolved P	Total P
Hay/Pasture	1759	1.4	1094.2	129.8	428.4	975.2	103.5	253.2
Cropland	586	3.6	3780.9	448.4	1367.5	3257.0	85.5	602.6
Forest	2832	1.1	165.8	19.7	136.4	219.3	7.1	29.8
Wetland	210	5.2	5.1	0.6	46.4	48.9	2.4	3.1
Disturbed	568	7.6	208.6	24.7	19.3	123.6	9.5	38.1
Turfgrass	143	0.9	39.7	4.7	76.5	96.4	5.5	11.0
Open Land	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bare Rock	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sandy Areas	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Unpaved Roads	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LD Mixed	7	4.3	0.0	0.1	1.1	4.0	0.2	0.4
MD Mixed	1226	11.9	0.0	54.4	735.7	2414.9	104.2	271.7
HD Mixed	2474	16.9	0.0	109.9	1484.8	4873.6	210.3	548.4
LD Residential	563	4.3	0.0	6.3	84.5	301.2	11.9	32.1
MD Residential	6847	7.2	0.0	304.1	4110.2	13491.1	582.2	1518.0
HD Residential	373	10.0	0.0	16.6	224.0	735.2	31.7	82.7
Farm Animals						0.0		0.0
Tile Drainage				0.0		0.0		0.0
Stream Bank				3674.1		3871.3		1060.4
Groundwater					42715.0	42715.0	722.8	722.8
Point Sources					0.0	0.0	0.0	0.0
Septic Systems					3557.8	3557.8	0.0	0.0
Totals	17588.9	7.10	5294.3	4793.3	54987.7	76684.4	1876.9	5174.2

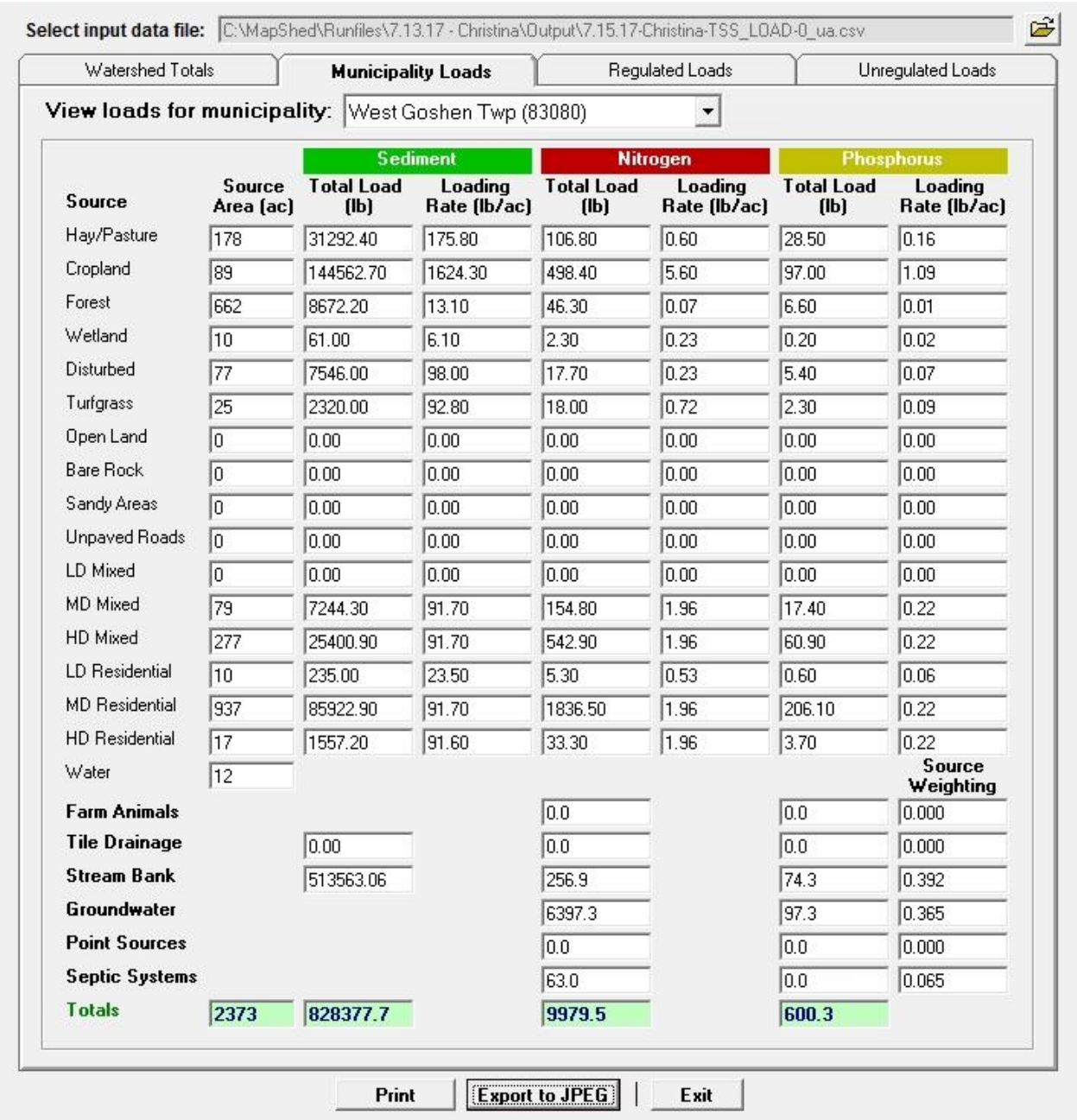
Go Back | Pathogen Loads | Export to JPEG | Print | Close

EX-01 Sediment Load Reduction = 4821.7 tons – 4793.3 tons = 28.4 tons = 56,800 lbs.

Total Existing BMP Sediment Load Reduction = 56,800 lbs./yr.

Combined TMDL Planning Area Sediment Load = 3,799,969.3 lbs. – 56,800 lbs. = <u>3,743,069.3 lbs.</u>

<u>Existing Pollutant Load for Christina River Basin</u> – Used to calculate remaining Long-term sediment load reductions.



Select input data file: C:\MapShed\Runfiles\7.13.17 - Christina\Output\7.15.17-Christina-TSS_LOAD-0_ua.csv

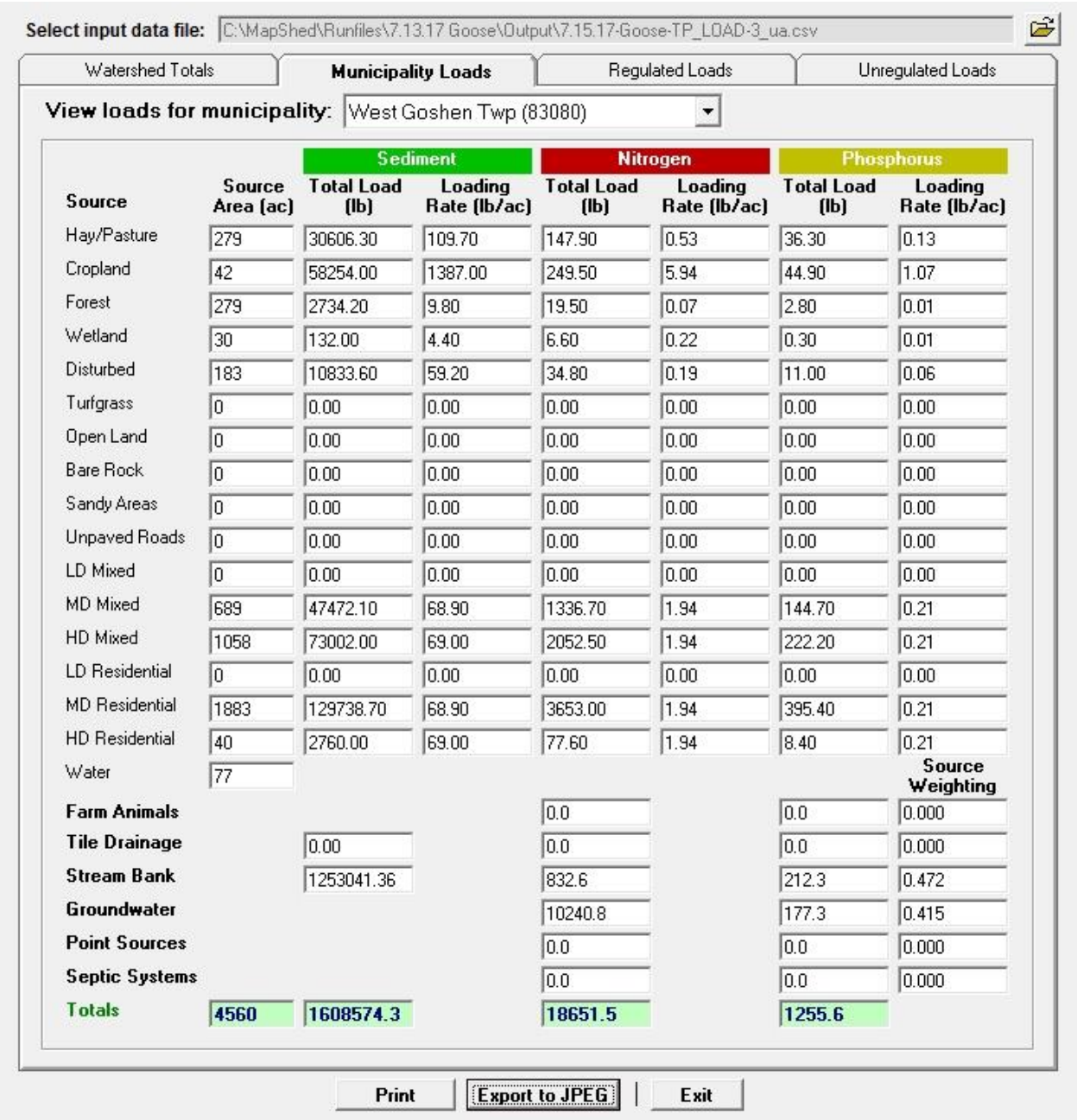
Watershed Totals | **Municipality Loads** | Regulated Loads | Unregulated Loads

View loads for municipality: West Goshen Twp (83080)

		Sediment		Nitrogen		Phosphorus	
Source	**Source Area (ac)**	**Total Load (lb)**	**Loading Rate (lb/ac)**	**Total Load (lb)**	**Loading Rate (lb/ac)**	**Total Load (lb)**	**Loading Rate (lb/ac)**
Hay/Pasture	178	31292.40	175.80	106.80	0.60	28.50	0.16
Cropland	89	144562.70	1624.30	498.40	5.60	97.00	1.09
Forest	662	8672.20	13.10	46.30	0.07	6.60	0.01
Wetland	10	61.00	6.10	2.30	0.23	0.20	0.02
Disturbed	77	7546.00	98.00	17.70	0.23	5.40	0.07
Turfgrass	25	2320.00	92.80	18.00	0.72	2.30	0.09
Open Land	0	0.00	0.00	0.00	0.00	0.00	0.00
Bare Rock	0	0.00	0.00	0.00	0.00	0.00	0.00
Sandy Areas	0	0.00	0.00	0.00	0.00	0.00	0.00
Unpaved Roads	0	0.00	0.00	0.00	0.00	0.00	0.00
LD Mixed	0	0.00	0.00	0.00	0.00	0.00	0.00
MD Mixed	79	7244.30	91.70	154.80	1.96	17.40	0.22
HD Mixed	277	25400.90	91.70	542.90	1.96	60.90	0.22
LD Residential	10	235.00	23.50	5.30	0.53	0.60	0.06
MD Residential	937	85922.90	91.70	1836.50	1.96	206.10	0.22
HD Residential	17	1557.20	91.60	33.30	1.96	3.70	0.22
Water	12						
							Source Weighting
Farm Animals				0.0		0.0	0.000
Tile Drainage		0.00		0.0		0.0	0.000
Stream Bank		513563.06		256.9		74.3	0.392
Groundwater				6397.3		97.3	0.365
Point Sources				0.0		0.0	0.000
Septic Systems				63.0		0.0	0.065
Totals	**2373**	**828377.7**		**9979.5**		**600.3**	

Print | Export to JPEG | Exit

<u>Existing Pollutant Load for Goose Creek Watershed</u> – Used to calculate remaining Long-term total phosphorus load reductions.



Select input data file: C:\MapShed\Runfiles\7.13.17 Goose\Output\7.15.17-Goose-TP_LOAD-3_ua.csv

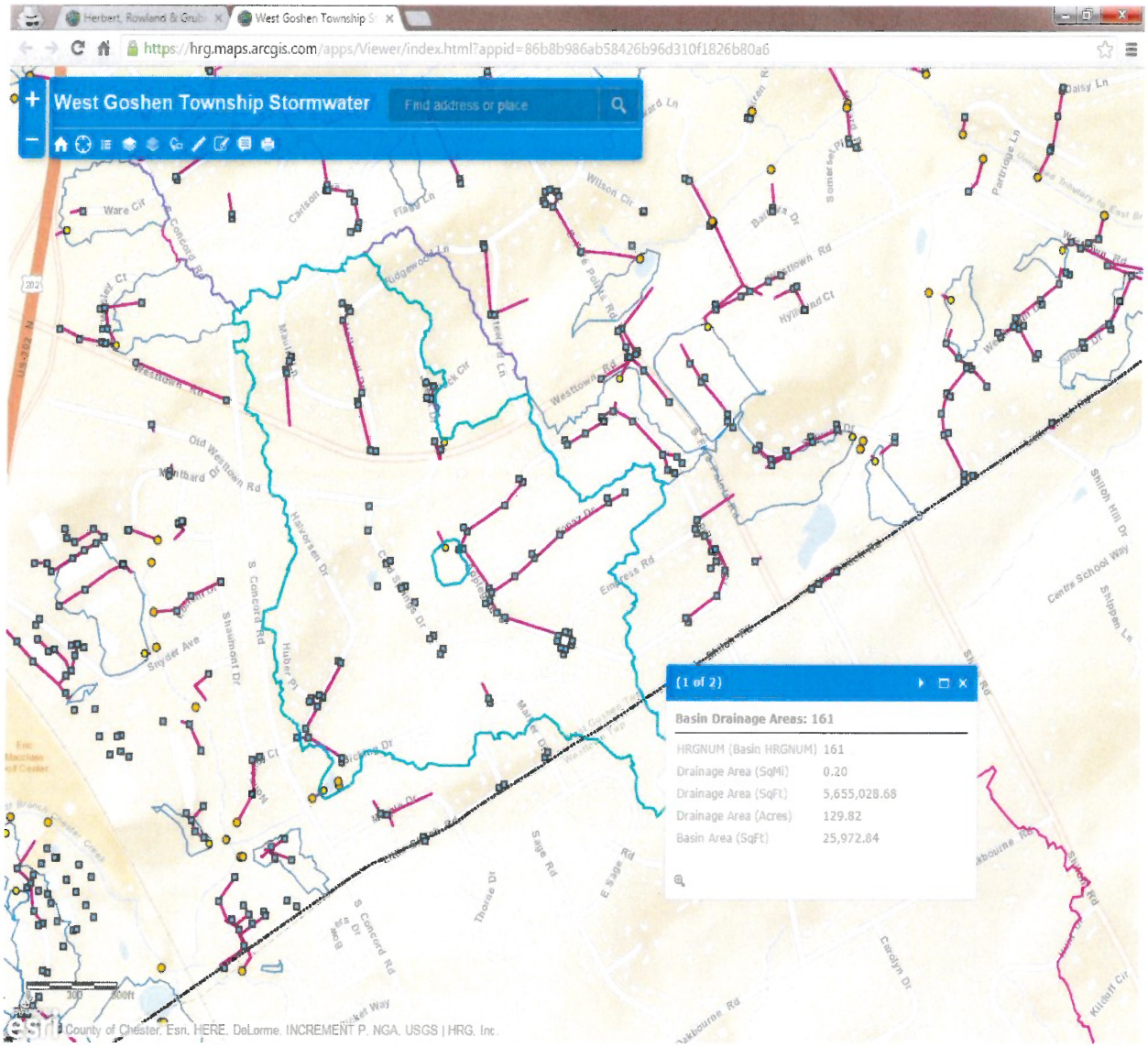
Watershed Totals | **Municipality Loads** | Regulated Loads | Unregulated Loads

View loads for municipality: West Goshen Twp (83080)

		Sediment		Nitrogen		Phosphorus	
Source	**Source Area (ac)**	**Total Load (lb)**	**Loading Rate (lb/ac)**	**Total Load (lb)**	**Loading Rate (lb/ac)**	**Total Load (lb)**	**Loading Rate (lb/ac)**
Hay/Pasture	279	30606.30	109.70	147.90	0.53	36.30	0.13
Cropland	42	58254.00	1387.00	249.50	5.94	44.90	1.07
Forest	279	2734.20	9.80	19.50	0.07	2.80	0.01
Wetland	30	132.00	4.40	6.60	0.22	0.30	0.01
Disturbed	183	10833.60	59.20	34.80	0.19	11.00	0.06
Turfgrass	0	0.00	0.00	0.00	0.00	0.00	0.00
Open Land	0	0.00	0.00	0.00	0.00	0.00	0.00
Bare Rock	0	0.00	0.00	0.00	0.00	0.00	0.00
Sandy Areas	0	0.00	0.00	0.00	0.00	0.00	0.00
Unpaved Roads	0	0.00	0.00	0.00	0.00	0.00	0.00
LD Mixed	0	0.00	0.00	0.00	0.00	0.00	0.00
MD Mixed	689	47472.10	68.90	1336.70	1.94	144.70	0.21
HD Mixed	1058	73002.00	69.00	2052.50	1.94	222.20	0.21
LD Residential	0	0.00	0.00	0.00	0.00	0.00	0.00
MD Residential	1883	129738.70	68.90	3653.00	1.94	395.40	0.21
HD Residential	40	2760.00	69.00	77.60	1.94	8.40	0.21
Water	77						
							Source Weighting
Farm Animals				0.0		0.0	0.000
Tile Drainage		0.00		0.0		0.0	0.000
Stream Bank		1253041.36		832.6		212.3	0.472
Groundwater				10240.8		177.3	0.415
Point Sources				0.0		0.0	0.000
Septic Systems				0.0		0.0	0.000
Totals	**4560**	**1608574.3**		**18651.5**		**1255.6**	

Print | Export to JPEG | Exit

EXISTING BMP EX-01 DETAILS


West Goshen Township Stormwater
Find address or place
https://hrg.maps.arcgis.com/apps/Viewer/index.html?appid=86b8b986ab58426b96d310f1826b80a6
(1 of 2)
Basin Drainage Areas: 161
HRGNUM (Basin HRGNUM) 161
Drainage Area (SqMi) 0.20
Drainage Area (SqFt) 5,655,028.68
Drainage Area (Acres) 129.82
Basin Area (SqFt) 25,972.84
County of Chester, Esri, HERE, DeLorme, INCREMENT P, NGA, USGS | HRG, Inc.

Aquascapes Unlimited
P.O. Box 364
Pipersville, PA 18947 *Attn: Kent Wise
(215) 766-8151 *Re: Bicking Basin

Acknowledgement

Ship Date	Order Num...
7/14/2009	661

Bill To

Township of Goshen
1025 Paoli Pike
West Chester, PA 19380
ATTN: Kent Wise
RE: Bicking basin

P.O. No.	Terms	Ship Via
	Net 30	UPS

	Description	Qty	Rate	Total
+	Eleocharis palustris PL/72	72	[redacted]	[redacted]
−	Mimulus ringens (Monkey Flower) PL/72	72		
+	Carex sp. PL/72	288		
−	Lobelia cardinalis (Cardinal Flower) PL/72	72		
−	Eupatorium perfoliatum (Boneset) PL/72	72		
−	Juncus effusus e plus <	72		
−	Hibiscus moscheutos (Swamp Rose Mallow) PL/72	72		
+	Acorus americana (Sweet Flag) PL/72	72		
−	Verbena hastata (Blue Vervain) PL/72	72		
	Box/Packing Fee	4		
	Shipping/ Handling Fee (TBD based on UPS Charges)			

Notes:

① I need a tax exempt form faxed to me in order to avoid the 6%.

② We can ship Next week with a P.O.

③ Please fax back w/ signature. & P.O.

Subtotal	[redacted]
Sales Tax	[redacted]
Total	[redacted]

If your order is correct, please sign and date below and return by FAX 215-766-8986.
Thank you

_____

0

G & A CLANTON, INC.

350 LAKE ROAD
AVONDALE, PA 19311

RAY, THIS IS A COPY WOODY

Invoice

Date	Invoice #
10/16/2008	11180

Bill To	Ship To
WEST GOSHEN TOWNSHIP 1025 PAOLI PIKE WEST CHESTER, PA 19380	

P.O. Numb...	Terms	Rep	Ship	Via	F.O.B.	Project
	UPON RECEIPT		10/16/2008			

Quantity	Item Code	Description	Price Each	Amount
15.95	SCREENED TOP SOIL	BY THE TON ON 10/7/08--TICKET #81726	[redacted]	[redacted]
6.37	SCREENED TOP SOIL	BY THE TON ON 10/7/08--TICKET #81736		

Req. #
P.O. #
Account #
Amount
Authorized

Thank you for your business.

1 1/2 % INTEREST AFTER 30 DAYS

Total [redacted]

Phone #	Fax #	E-mail
610-869-8971	610-869-2485	CLANTONTOPSOIL@AOL.COM

Pipe Xpress, Inc.
821 East Washington Street
West Chester, PA 19380
610-918-7120
FAX 610-918-1328

Copy

Invoice

Date	Invoice #
10/10/2008	39168

Bill To	Ship To
WEST GOSHEN TOWNSHIP BOARD OF SUPERVISORS 1025 PAOLI PIKE WEST CHESTER, PA 19380	ROAD DEPT

P.O. No.	Terms	Due Date	Rep	Ship Via	Ordered
VERBAL	2% 10 Net 30	11/9/2008		PICK UP	MARK

Item	Description	Ordered	Rate	Amount
MG24	24 STD METAL GRATE	1	[redacted]	[redacted]

Reg. #
P.O. #
Account #
Amount
Authorized

Thank you for your business.

Subtotal	[redacted]
Sales Tax 0	[redacted]
Total	[redacted]

Pipe Xpress, Inc.

821 East Washington Street
West Chester, PA 19380
610-918-7120
FAX 610-918-1328

Invoice

Date	Invoice #
9/17/2008	38737

Bill To
WEST GOSHEN TOWNSHIP BOARD OF SUPERVISORS 1025 PAOLI PIKE WEST CHESTER, PA 19380

Ship To
CUSTOMER PICK UP

P.O. No.	Terms	Due Date	Rep	Ship Via	Ordered
VERBAL	2% 10 Net 30	10/17/2008		PICK UP	MARK

Item	Description	Ordered	Rate	Amount
T2415	24 X 15 PE DBL WALL CORR TEE PE X PE X PE	1	[redacted]	[redacted]
MMCPL18	18 MARMAC POLYSEAL COUPLER	1	[redacted]	[redacted]
Freight	FRT-IN SHIPPING CHARGE	1	[redacted]	[redacted]

Reg. #
P.O. #
Account #
Amount
Authorized

Thank you for your business.

Subtotal	[redacted]
Sales Tax 0	[redacted]
Total	[redacted]

Bill To:
West Goshen Township
1025 Paoli Pike
West Chester, PA 19380-4699
Phone: (610) 696-5266

Purchase Order #
00001533-00 FY 2008
Page Number: 1

NOTICE TO VENDOR

Purchase order number must appear on all packing slips and invoices in order for invoices to be processed for payment.

Vendor
URS CORPORATION 1200 PHILADELPHIA PIKE WILMINGTON, DE 19809

Ship To:
WEST GOSHEN TOWNSHIP ATTN: ADMINISTRATION DEPT 1025 PAOLI PIKE WEST CHESTER, PA 19380-4699

Requisition
00001619

Date Ordered	Vendor Number	Date Required	Freight Method/Terms	Department/Location
10/21/08	003728			ADMINISTRATION

LN	Description/Part Number	QTY	Cost Each	Ext. Price
001	Design of plant selections and locations for vegetating the rehabilitated Bicking Drive stormwater basin. 01446-30270	1.0 Each	PO Total	

APPROVED FOR PURCHASE — DATE
Richard J. Craig — 10/27/08
APPROVED FOR PAYMENT — DATE

PAID BY CHECK # — DATE

APPENDIX E

Sediment Wasteload Allocation for West Goshen Township

US EPA (2006). *"Total Maximum Daily Loads for Bacteria and Sediment in the Christina River Basin, Pennsylvania, Delaware, and Maryland"*(pg. 4-16)

Table 4-8. Average annual sediment allocations for towns in Brandywine Creek Watershed

Township	Baseline (ton/yr)	TMDL (ton/yr)	Percent Reduction
BIRMINGHAM TWP	310.81	130.35	58.06%
COATESVILLE CITY	231.29	79.76	65.52%
EAST BRADFORD TWP	1185.00	467.17	60.58%
EAST FALLOWFIELD TWP	803.23	426.42	46.91%
EAST MARLBOROUGH TWP	366.70	139.44	61.98%
HIGHLAND TWP	384.80	238.86	37.93%
HONEY BROOK BORO	20.58	13.23	35.70%
HONEY BROOK TWP	813.84	558.76	31.34%
MODENA BORO	27.96	12.46	55.43%
NEWLIN TWP	144.18	59.59	58.67%
PARKESBURG BORO	52.11	32.35	37.93%
PENNSBURY TWP	113.98	43.48	61.85%
POCOPSON TWP	821.21	320.79	60.94%
SADSBURY TWP	289.73	172.13	40.59%
THORNBURY TWP	82.17	34.46	58.06%
VALLEY TWP	485.14	164.64	66.06%
WALLACE TWP	21.74	17.41	19.92%
WEST BRADFORD TWP	283.22	121.60	57.07%
WEST CALN TWP	68.28	43.07	36.92%
WEST GOSHEN TWP	461.32	180.51	60.87%

Total phosphorus Wasteload Allocation for West Goshen Township

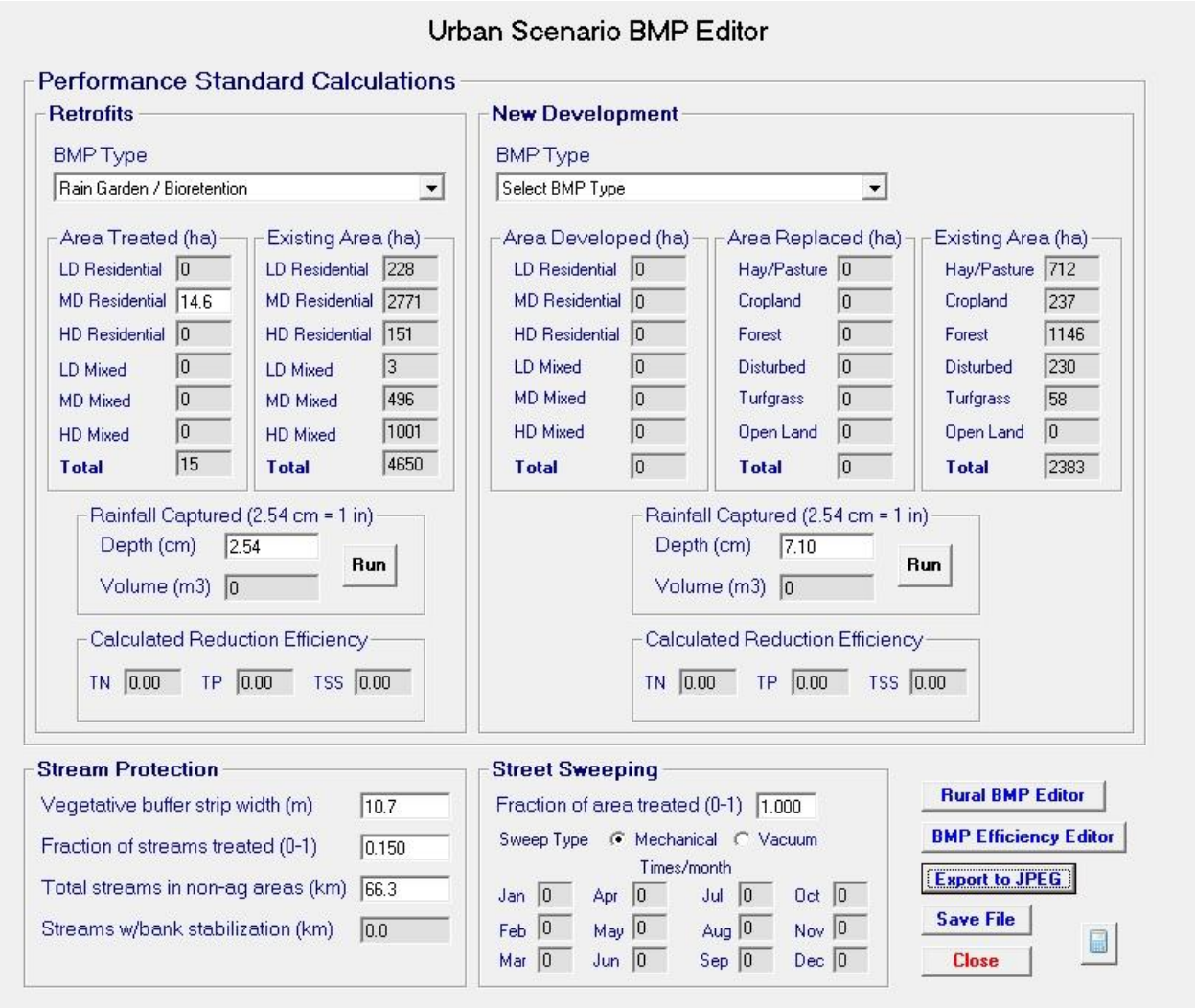
US EPA (2008). "*Nutrient Total Maximum Daily Load in Goose Creek Watershed, Pennsylvania,"*(pg. 3-6)

Table 3-3: Land Based Non-Point TP Load in the Goose Creek Watershed by MS4 Area

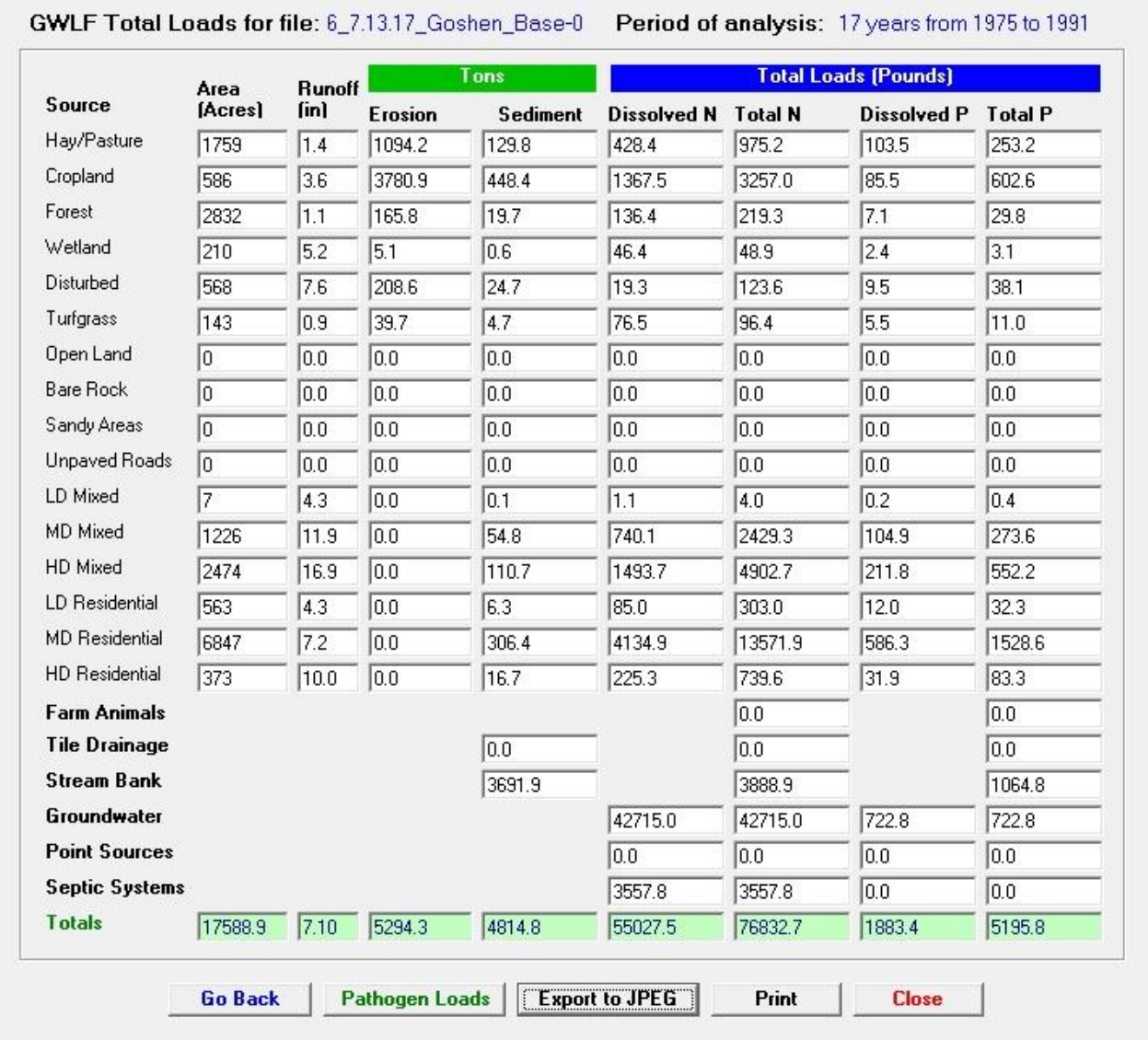
MS4 Permit Holder	Area by MS4	Existing TP Load	Allocated TP Load	Required Reduction
	acres	lb/day	lb/day	
West Goshen Township	1,488	1.16	0.54	53.9%
West Chester Borough	310	0.24	0.11	53.9%
Westtown Township	1,791	1.40	0.64	53.9%
Thornbury Township (Chester County)	772	0.60	0.28	53.9%
Thornbury Township (Delaware County)	113	0.09	0.04	53.9%
Total	**4,474**	**3.49**	**1.61**	**53.9%**

APPENDIX F

Proposed BMP-01 Pollutant Load Reduction - MapShed BMP-01 Input Exhibit



<u>Proposed BMP - 01 Pollutant Reduction</u> - MapShed Pollutant Loads by Source for Entire Modeled Area w/ BMP-01



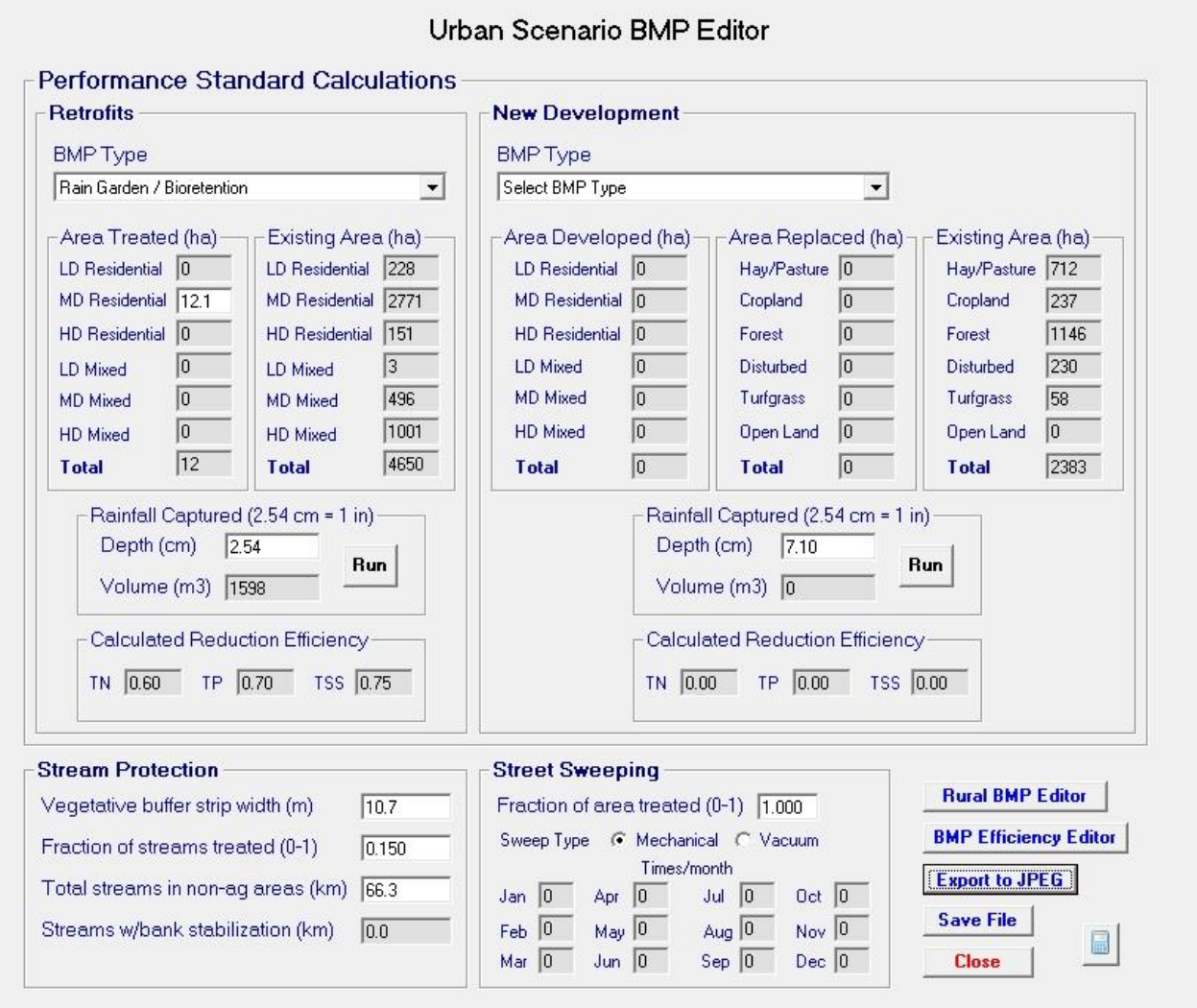
GWLF Total Loads for file: 6_7.13.17_Goshen_Base-0 Period of analysis: 17 years from 1975 to 1991

Source	Area (Acres)	Runoff (in)	Tons		Total Loads (Pounds)			
			Erosion	Sediment	Dissolved N	Total N	Dissolved P	Total P
Hay/Pasture	1759	1.4	1094.2	129.8	428.4	975.2	103.5	253.2
Cropland	586	3.6	3780.9	448.4	1367.5	3257.0	85.5	602.6
Forest	2832	1.1	165.8	19.7	136.4	219.3	7.1	29.8
Wetland	210	5.2	5.1	0.6	46.4	48.9	2.4	3.1
Disturbed	568	7.6	208.6	24.7	19.3	123.6	9.5	38.1
Turfgrass	143	0.9	39.7	4.7	76.5	96.4	5.5	11.0
Open Land	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bare Rock	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sandy Areas	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Unpaved Roads	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LD Mixed	7	4.3	0.0	0.1	1.1	4.0	0.2	0.4
MD Mixed	1226	11.9	0.0	54.8	740.1	2429.3	104.9	273.6
HD Mixed	2474	16.9	0.0	110.7	1493.7	4902.7	211.8	552.2
LD Residential	563	4.3	0.0	6.3	85.0	303.0	12.0	32.3
MD Residential	6847	7.2	0.0	306.4	4134.9	13571.9	586.3	1528.6
HD Residential	373	10.0	0.0	16.7	225.3	739.6	31.9	83.3
Farm Animals						0.0		0.0
Tile Drainage				0.0		0.0		0.0
Stream Bank				3691.9		3888.9		1064.8
Groundwater					42715.0	42715.0	722.8	722.8
Point Sources					0.0	0.0	0.0	0.0
Septic Systems					3557.8	3557.8	0.0	0.0
Totals	17588.9	7.10	5294.3	4814.8	55027.5	76832.7	1883.4	5195.8

Go Back | Pathogen Loads | Export to JPEG | Print | Close

BMP-01 Sediment Load Reduction = 4821.7 tons – 4814.8 tons = 6.9 tons = 13,800 lbs.

Proposed BMP-02 Pollutant Load Reduction - MapShed BMP-02 Input Exhibit



<u>Proposed BMP - 02 Pollutant Reduction</u> - MapShed Pollutant Loads by Source for Entire Modeled Area w/ BMP-02

GWLF Total Loads for file: 7_7.13.17_Goshen_Base-0 **Period of analysis:** 17 years from 1975 to 1991

Source	Area (Acres)	Runoff (in)	Tons		Total Loads (Pounds)			
			Erosion	Sediment	Dissolved N	Total N	Dissolved P	Total P
Hay/Pasture	1759	1.4	1094.2	129.8	428.4	975.2	103.5	253.2
Cropland	586	3.6	3780.9	448.4	1367.5	3257.0	85.5	602.6
Forest	2832	1.1	165.8	19.7	136.4	219.3	7.1	29.8
Wetland	210	5.2	5.1	0.6	46.4	48.9	2.4	3.1
Disturbed	568	7.6	208.6	24.7	19.3	123.6	9.5	38.1
Turfgrass	143	0.9	39.7	4.7	76.5	96.4	5.5	11.0
Open Land	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bare Rock	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sandy Areas	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Unpaved Roads	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LD Mixed	7	4.3	0.0	0.1	1.1	4.0	0.2	0.4
MD Mixed	1226	11.9	0.0	54.8	739.1	2426.0	104.8	273.2
HD Mixed	2474	16.9	0.0	110.5	1491.6	4896.0	211.4	551.3
LD Residential	563	4.3	0.0	6.3	84.9	302.6	11.9	32.3
MD Residential	6847	7.2	0.0	305.9	4129.1	13553.2	585.3	1526.2
HD Residential	373	10.0	0.0	16.7	225.0	738.5	31.9	83.2
Farm Animals						0.0		0.0
Tile Drainage				0.0		0.0		0.0
Stream Bank				3693.0		3891.2		1064.8
Groundwater					42715.0	42715.0	722.8	722.8
Point Sources					0.0	0.0	0.0	0.0
Septic Systems					3557.8	3557.8	0.0	0.0
Totals	17588.9	7.10	5294.3	4815.1	55018.3	76804.6	1881.9	5191.8

Go Back | Pathogen Loads | Export to JPEG | Print | Close

BMP-02 Sediment Load Reduction = 4821.7 tons – 4815.1tons = 6.6 tons = 13,200 lbs.

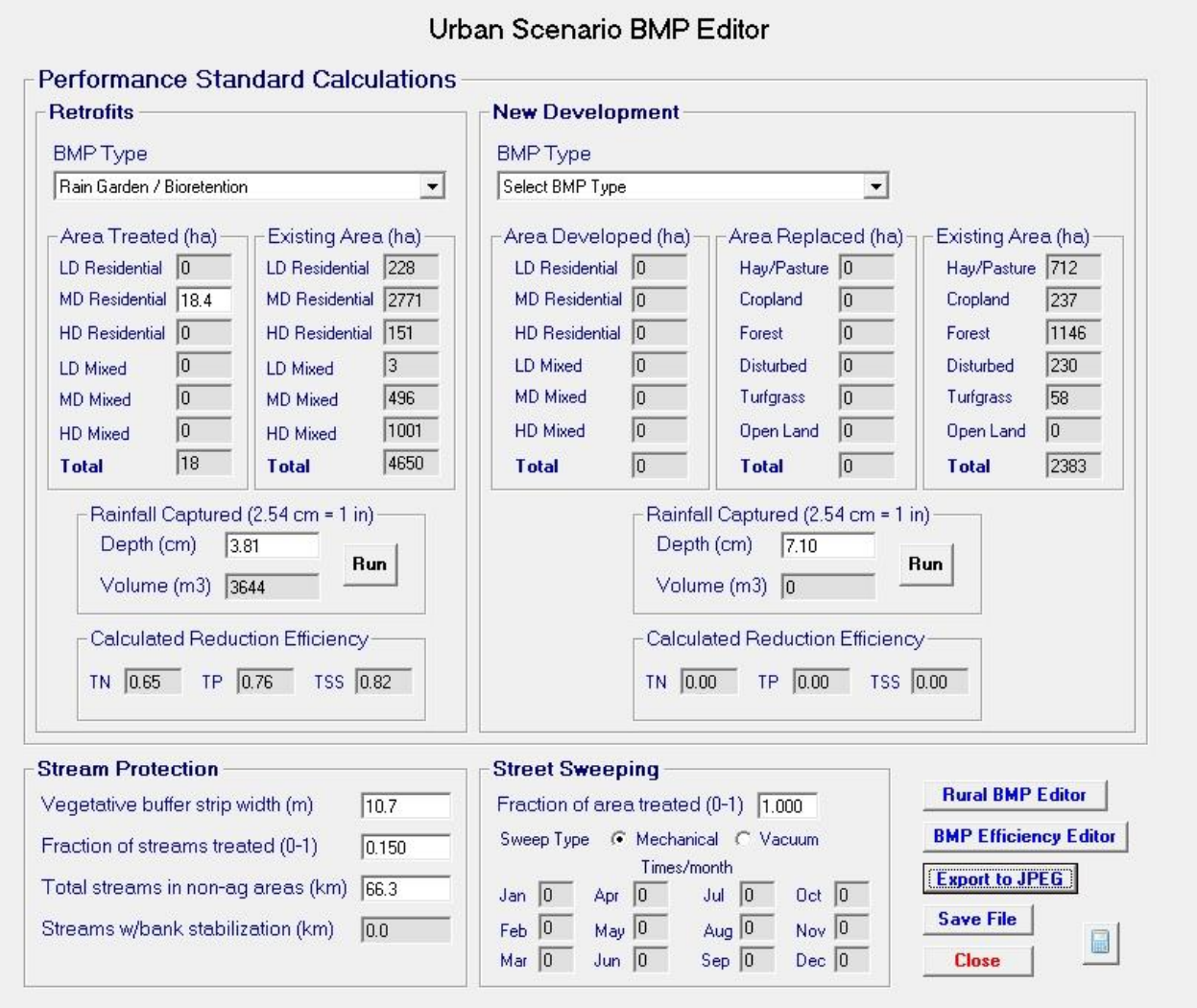
BMP-03 Stream Restoration Sediment Load Reduction Calculation

1,150 ft. x 115 lbs./ft. = 132,250 lbs. sediment reduction

BMP-04 Stream Restoration Sediment Load Reduction Calculation

1,725 ft. x 115 lbs./ft. = 198,375 lbs. sediment reduction

Proposed BMP-04 Pollutant Load Reduction - MapShed BMP-04 Input Exhibit for bioretention only



<u>Proposed BMP - 04 Pollutant Reduction</u> - MapShed Pollutant Loads by Source for Entire Modeled Area w/ BMP-04 bioretention only

GWLF Total Loads for file: 8_7.13.17_Goshen_Base-0 **Period of analysis:** 17 years from 1975 to 1991

Source	Area (Acres)	Runoff (in)	Tons		Total Loads (Pounds)			
			Erosion	Sediment	Dissolved N	Total N	Dissolved P	Total P
Hay/Pasture	1759	1.4	1094.2	129.8	428.4	975.2	103.5	253.2
Cropland	586	3.6	3780.9	448.4	1367.5	3257.0	85.5	602.6
Forest	2832	1.1	165.8	19.7	136.4	219.3	7.1	29.8
Wetland	210	5.2	5.1	0.6	46.4	48.9	2.4	3.1
Disturbed	568	7.6	208.6	24.7	19.3	123.6	9.5	38.1
Turfgrass	143	0.9	39.7	4.7	76.5	96.4	5.5	11.0
Open Land	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bare Rock	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sandy Areas	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Unpaved Roads	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LD Mixed	7	4.3	0.0	0.1	1.1	4.0	0.2	0.4
MD Mixed	1226	11.9	0.0	54.7	738.4	2423.8	104.7	272.9
HD Mixed	2474	16.9	0.0	110.4	1490.3	4891.6	211.2	550.7
LD Residential	563	4.3	0.0	6.3	84.8	302.3	11.9	32.2
MD Residential	6847	7.2	0.0	305.5	4125.5	13541.1	584.7	1524.6
HD Residential	373	10.0	0.0	16.6	224.8	737.9	31.9	83.1
Farm Animals						0.0		0.0
Tile Drainage				0.0		0.0		0.0
Stream Bank				3689.9		3886.7		1064.8
Groundwater					42715.0	42715.0	722.8	722.8
Point Sources					0.0	0.0	0.0	0.0
Septic Systems					3557.8	3557.8	0.0	0.0
Totals	17588.9	7.10	5294.3	4811.4	55012.3	76780.6	1880.9	5189.2

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BMP-04 Bioretention Sediment Load Reduction = 4821.7 tons – 4811.4 tons = 10.3 tons = 20,600 lbs.

Total Short-term sediment load reduction = 378,225 <u>lbs./yr.</u>

Long-term Pollutant Goal Calculations

Total Short-term sediment load reduction

- 378,225 lbs./yr.

Goose Creek 5% TP reduction equals 10% TSS reduction

- Goose Creek sediment load = 1,608,574.3 lbs
- 10% TSS reduction = 1,608,574.3 lbs x 0.1 = 160,857.4 lbs.
- 5% TP reduction achieved = 1,255.6 lbs. x 0.05 = 62.8 lbs.

Remaining sediment load reduction

- 378,225 lbs. – 160,857.4 lbs. = 217,367.6 lbs

Christina River Basin sediment reduction from Short-term BMPs

- 217,367.6 lbs. ÷ 828,377.7 lbs. = 0.26 x 100 = 26%